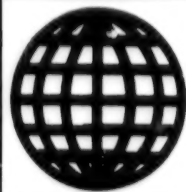


JPRS-CST-93-012  
29 June 1993



**FOREIGN  
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# ***JPRS Report***

# **Science & Technology**

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***China***

# Science & Technology China

JPRS-CST-93-012

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29 June 1993

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**State Planning Commission's S&T Priorities in 1993**  
93FE0615B Beijing KEJI RIBAO [SCIENCE AND  
TECHNOLOGY DAILY] in Chinese 22 Mar 93 p 1

[Article by Gu Xiaoxiang [7357 1321 5980] and Ren Lin  
[0117 2651]]

[Text] It has been learned from the Department of Science and Technology of the State Planning Commission that in order to use science and technology to promote economic development, to establish a socialist market economy, to strengthen research on S&T development strategy, and to fully utilize the productivity of science and technology, the State Planning Commission will focus on the following areas:

- To establish a system of evaluation to assess the contributions of advances in science and technology to economic growth. In the development of macroeconomy, advancement in science and technology should be pushed forward with a steadfast and unwavering effort. In 1993, a system of evaluation and assessment on the contributions of science and technology to economic growth was deployed based on the criteria of typical regions, occupations, department and business enterprises.
- Strengthen the conversion of science and technology achievements to the productive force and actively push forward and arrange the technically mature projects to be transferred to the business enterprises in a planned, systematic and hierarchical, market-oriented way. At the same time, strengthening the weak spots in the conversion of science and technology achievement to the business enterprises is also planned, and arrangements for key state industrial tests and the construction projects of state engineering research centers is also made.
- Strengthen the development and application of certain technologies pivotal to the nation's economic and social development. Increase the state's investment in 36 technologies which can elevate the nation's overall technological level and installation level. Efforts will be focused on getting important technological breakthroughs and the gradual transfer of the results to production.
- Continue to implement the nation's key science and technology projects planned for the year. Work on the coordination and supervision of Science and Technology Key Projects Breakthrough Plan, High-Tech program and Basic Research program. Complete the building of National Key Laboratories and other important basic infrastructural facilities.
- Further deepen the reform of the science and technology system by studying and giving suggestions on various policies and macroscopic control measures that would attract the technological force to the national economic arena, and exploring the policies on technological investment system. Let the state plans and the market

economy and the superior conditions of local economy fully play their roles to promote the involvement of the whole society in science and technology.

**Products of Nuclear Power Institute Enter Market**  
93FE0710B Beijing ZHONGGUO KEXUE BAO  
[CHINESE SCIENCE NEWS] in Chinese 5 May 93 p 1

[Article by Di Peitian [5049 1014 1131]]

[Text] A new technology advanced by the Chinese Nuclear Power Institute, a nuclear radiation technique, is generating considerable excitement nationwide. The institute has irradiated more than 100 products with neutrons and gamma rays and the quality has exceeded advanced international standards.

Nuclear irradiation is a new, high-tech method for the benefit of mankind. It includes neutron irradiation with a reactor and gamma ray irradiation with gamma ray devices at irradiation stations.

The high flux reactor at this institute is China's largest neutron source; irradiation research has been going on since the 1980's for nuclear reactor fuel components and samples. Effects of nuclear radiation on reactor pressure vessel steel and structural components within the reactor have been under investigation. Studies of irradiation-induced color changes in gems have also been made. This research has produced fruitful results and contributed greatly to China's nuclear power and high activity isotopes.

Using China's largest gamma ray irradiation facility, the institute has also conducted irradiation research for heat-shrink products and did most of the irradiation tasks in Sichuan. Other research conducted includes fragmentation of polytetraethylene, anti-aging of rubber products, antiseptic treatment of natural emulsion, disinfection of medical products, and disinfection of Chinese herbal medicine and foodstuffs. This research not only produced ample results but has also found wide applications in industry, agriculture, and medicine.

The institute developed Co-60 long distance source and P-32 glass microspheres, which contributed to cancer treatment and rescue missions. Tr-192 $\gamma$ , Co-60, and Tm-170 flaw detection sources developed by the institute have played an important role in the inspection of pressure vessels. Neutron doping of single crystal silicon has improved the quality of silicon wafers and promoted the advancement of China's electronics industry.

The multitude of technologies and products developed by the institute not only filled a void in China but also substituted imports. Some of the products and technologies have exceeded advanced international standards. International materials organizations have rated some of these achievements highly and issued merit certificates.



Examples are neutron irradiation effects of reactor pressure vessel steel, radiation monitoring of power station pressure vessels, and the irradiation experiments of toxic, volatile boron silicate glass. Medical gel-type Mo-Tc generator is an exclusive technology and has already entered the market with commercial products.

### **Military-Civilian Conversion at MAS's Third Academy**

93FE0565A Tianjin KEXUE XUE YU KEXUE JISHU GUANLI [SCIENCE OF SCIENCE AND MANAGEMENT OF S&T] in Chinese Vol 14 No 3, Mar 93 pp 25-27

[Article by Qu Chen [2575 5256], Yang Xiaoxiang [2799 1420 4161], Zhao Jinshan [6392 6855 1472], Zhang Zhenzhong [1728 6966 0022], and Li Guorong [2621 0948 2837] of the MAS's Third Academy. Responsible editors Zheng Weijian [6774 4850 0256] and Xu Jing [6079 7234]]

[Text] The management mode in the space system in China has long been centered around prototype research institutes. Under these institutes there are whole system design departments, general assembly plants, research institutes, and subsystem manufacturing plants. Under the organization, command, coordination and control of the prototype research institute, the tasks of research, manufacturing and testing are completed with joint efforts of the departments, plants and research institutes. This special mode of management is also known as the "system engineering management mode."

As the macro-environment of a socialist market economy takes form and faces favorable opportunities in industries here and abroad, China is surely going to proceed with the conversion of its space industries.

### **I. Formation and Problems in the System Engineering Management Mode for Prototype Products**

The formation of prototype product system engineering management mode is determined by the characteristics of prototype products in aviation.

1. Technically, space prototype products require large-scale systems engineering and sophisticated technology. The entire structure consists of many subsystems and each subsystem in turn consists of numerous instrument meters and components. Thus, the emphasis is on the optimization and coordination of the entire system.

2. In terms of specialties, it involves many specialties and professions from different fields. The development of a prototype may involve as many as 1,000 organizations in the country.

3. In terms of development process, it must go through preliminary research, design, manufacturing, and testing.

4. In terms of time, the development cycle is long. It takes at least 3 to 5 years and sometimes as many as 10 years to succeed in the development of one prototype.

5. In terms of the nature of the work, it is a state mandated task and has national political and military ramifications.

From the above characteristics, it is clear that this type of system engineering requires a strong centralized technology and administrative coordination system.

After 30 years of trial and exploration, the present system engineering management mode of the prototype research institute was formed. Experience showed that the system was compatible with the characteristics of space prototype products and has played an important role in the development of the space industry.

In the 1990's, the situation underwent some major changes. First, the international trend has been toward peace and production was reduced drastically. The manufacturing function of the prototype institute was very much in idle and funding was extremely scarce. Second, the domestic effort has been centered on economic construction and military expenses were cut back severely. Under the policy of conversion, the prototype institute has changed from producing only military products to both military and civilian products. Faced with today's situation, the old management system is no longer appropriate and the management mechanism must be changed.

### **II. Mechanism Conversion Must Be Preceded by Change of Concept**

#### **1. Changing "Planned Economy" Concept to "Market Economy" Concept**

For many years the space enterprise has engaged in purely on-demand military production and operated under the planned economy. It has formed a mode of thinking and management operation based on planned supply, production, sales and allocation of personnel, money and materials. This mode of management appeared to be out of place and inapplicable in the reform atmosphere of the late 1980's. At that time the space enterprise did not succeed in developing civilian products and the quality of military products also dropped at times. Compared to the reform of the 1980's, the socialist market economy under practice today is far more complex and far-reaching. If the space industry does not break away from the old constraints and consciously practice the rules of value, competition and demand and supply in the market economy, it will not survive in the "survival of the fittest" social environment.

#### **2. Change the Concept of "Unified" to the Concept of "Diversified Development"**

Under the old planned economy, the highly centralized and mandatory planning has allowed only one management mode, one operating mechanism and one function

for government organizations, business units and enterprises. The market economy, on the other hand, demands a separation of government and enterprise and a separation of ownership and management. Under the principle of macroscopic management and microscopic diversity, each government, business, enterprise and manufacturing unit has its own mission and mode of operation in the overall development. In addition, the most distinct feature of an enterprise is to create more social commodity wealth in order to satisfy the material and cultural needs of the market and the people. We must therefore face the market and adjust and deploy the personnel, financial and material resources based on market needs. A versatile operating mechanism for diversified development of military and civilian products should be formed.

### 3. Changing From a "Passive" to an "Active" Concept

For a long time the space industry has grown accustomed to a passive mode of operation based on administrative jurisdiction. The market economy, however, requires the enterprise to face the market and determine the development goals of business survival according to the market. To ensure that enterprises may adjust and operate on their own, the State Council issued a "People-owned industry-enterprise conversion regulation." In this regulation, business operation rights were stipulated for 14 different areas and the authority for implementing mandatory production projects were also clearly defined. This document provided a legal assurance for "special" military industries such as space industry. The space enterprise must break away from the traditional ideology and the trap of passiveness. It must determine its business strategy and reform its current system to follow the rules of a market economy.

### 4. Changing "Fighting Alone" to "Fighting Together"

Because of security reasons, the space industry has formed its own little world. In the market economy, with the exception of state security regulation for military products and commercial proprietary technologies, there should be large-scale joint operation. In terms of operation the industry should develop its advantages in technology, facility, plant, and personnel resources. In terms of management the industry should continue to develop the advantages of system engineering and also diversify and engage in large-scale joint business. These efforts will make the enterprises a real independent producer and manager of commercial products responsible for its profit or loss.

### 5. Changing the Concept of False Equality to Reward According to the Effort

For a long time there existed in the space industry an ideology of "equitable" distribution of compensation. This may be acceptable in a planned economy of centralized distribution, and sales, but in a market economy the distribution should be made on the basis of the quality and quantity of products an individual provides

society. To this end we must adhere to the principle of compensation commensurate with effort. The perverse situation of missile experts making less money than a street vendor must be corrected.

### III. Strategies and Recommendations for Converting the Management Mechanism

In the conversion of the space industry, attention should be given to the following issues.

1. In the conversion process, the departments should be patient and not go on their own in taking short-term gains. We should develop the advantages of the entire enterprise and the system engineering mode and work together to promote the development of the industry.

2. Enhance the sense of science and technology in the enterprise and direct the attention to personnel training and technology reform.

3. Establish an incentive mechanism so that all the workers may contribute to the development of the enterprise.

To facilitate the conversion of the management mechanism, the authors would like to offer the following solutions and recommendations.

#### 1. Formulate an Overall Management Development Strategy

The overall management development strategy for the space enterprise consists of development in military and civilian products. The premise for military product development is to maintain high-tech development in space industries. Based on ministerial and institutional plan for prototype development, equipment task and military product trade task should be combined. Predictive quantitative and qualitative analysis should be made for the total military production by the enterprise in a given period of time. Based on the prediction, a 10 to 20 percent safety margin should be included as a reserve for military production. A stable core team should be reserved for military production in case there are unexpected situations. In the meantime, a civilian product development strategy must also be formulated. The latter will be an aggressive strategy for large-scale development of civilian products. It shall rely mainly on finding the potential strength in the enterprise and joining force with other enterprises. These measures will prevent the space industry from having large fluctuations in the economic benefits due to changes in military production missions. The strategy will make the space enterprise a military-civilian high-tech industry to join the market competition.

#### 2. Establish a Mixed Management System

The space enterprise should establish a flexible, high-efficiency military-civilian combined management system as soon as possible. It may adopt a combination system of centralized authority for military products and delegate authority for civilian products. For military

products, it may continue to use the linear function management system; for civilian products, it could adopt the short-line management system or business department system. A mixed system is needed to suit the different characteristics of military and civilian production mode. The dual-track system means separate production lines for military and civilian goods by establishing relatively independent, isolated, noninterfering and self-contained production bases. This will fundamentally solve the problems of producing military and civilian products on the same production line so that each may proceed on separate but coordinated stable and sustained tracks.

### 3. Clearly Define the Direction of Civilian Products

To establish development projects in civilian products, attention should be given to the identification of the overall advantages, namely the advantages of the system engineering of the space enterprise. The direction of the civilian effort should be defined under the principle of common technology and long-term coexistence and coordinated development with the military technology. There should be four directions of conversions in civilian products development. In terms of product utilization, the conversion is from directly providing products to the consumers' market to providing technical facility for the national economic development. In terms of grades of products, the conversion is from general technology low-grade products to high-tech electromechanical products. In terms of essential factors of production, the conversion will be from labor-intensive products to technology-intensive products. In terms of variety, the conversion will be from producing low value-added consumable to producing import-substituting components, and large variety, small batch civilian goods.

### 4. Develop Diversified Multi-Purpose Economic Technology

The key to the integrated management development strategy is to put civilian products development on a solid basis. Based on its own strength, the space enterprise must actively seek out avenues to diversify into multi-purpose economic technologies. The avenues are: 1) Actively seek support of local government and related departments to include civilian products development into local-area development plans and business development plans. 2) Actively develop technical collaboration with research planning units within and without the ministry and department and with colleges and universities, mainly in the development of new technology, new manufacturing methods, and new materials. 3) In the development of civilian products, the space enterprise should adopt a professional collaboration approach. One should avoid producing all the products within the enterprise. Based on the nature of the enterprise, emphasis should be in overall assembly and testing and the manufacture of key components. Other parts may be produced in distributed locations. 4) In order to solve the problem of insufficient development funds for

civilian products, the stock-holding system should be adopted. 5) Establish joint venture businesses and promote the development of outward economy.

### '21st Century Science City' To Be Built in Wuhan

93P60277A Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 7 May 93 p 1

[Article by Liu Liang [0491 0404] and Li Yongsheng [2621 3057 0581]]

[Summary] A U.S. investment company recently signed an agreement with Huazhong (Central China) Science and Technology University to build a "21st Century science city" in Wuhan. The U.S. investment company will invest 300 million yuan in the project, while Huazhong University will provide about 50 mu of land. Building groups covering 120,000 square meters will house information center, S&T industrial center, cultural entertainment center, combined service center, and training center. The intention of building the city is to use the university and its vicinity's excellent intellectual environment to absorb world advanced science and technology, and promote the advancement of science and technology in central China. The U.S. investment company is headquartered in the State of Virginia, and it is the company's first investment in China's higher education. The U.S. investment company has also signed a joint agreement with Huazhong Science and Technology University to establish "Gaohua [7559 5478] Economic and Technological Investment and Consultation Company."

### Significance of Developing Information Industry in China

93FE0569A Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 2, Mar 93 pp 44-45

[Article by Jin Jian [6855 1696] and Chen Xiaobo [7115 2556 3134] of Jinan University: "Significance of, Measures for Developing Domestic Information Resources"]

[Text] Recently in some countries, especially developed countries, the information industry sector has increased its proportion while the materials industry has decreased, resulting in a hard-to-soft transformation in industrial structure. This is a shift from the traditional manufacturing-oriented economic model to a new growth model based largely on cutting-edge information technology. According to some related statistics, the proportion of information industry in a nation's gross national product (GNP) statistics is 40 percent to 60 percent in developed countries, 25 percent to 40 percent in the newly industrialized economies, and below 25 percent in developing countries.

China is a developing country. Economically it has achieved some unprecedented progress since its founding 43 years ago, but there still exists a huge gap compared with the developed countries. Currently, it is



of enormous significance that China, in order to catch up with the developed countries, adopt a strategy of exploiting information resources by promoting the information industry, deepening the utilization of materials and energy through developing information technology, and achieving preemptive market entry to acquire the assurance of success in fierce global competition. In his article, "On the Development Trends of the Global Electronic Information Industry and the Strategic Issues of Developing China's Information Industry," General Secretary Jiang Zemin pointed out that "through the information technology's value-added impact on the economy, we can increase China's economic efficiency, reduce costs, and fully utilize China's well-developed steel, coal, electric, and oil industrial bases, leading to a several-fold increase in GNP." Therefore, it is imperative that China increase the manufactured goods' value to propel the national economy through developing information technology, push the national economy to be more information-oriented, and to transform the extensive economic structure into an intensive one, if it is to achieve rapid economic growth.

As discussed above, developing the information industry has the following significance in the Chinese socialist market economy:

First, information technology predetermines the development of the Chinese socialist market economy. Information resources as opposed to the two large resources of materials and energy, play a unique role in economic activities. The modern economic operation is a huge and complex system, full of random factors controlled by numerous variables during the operating process, and requires a huge amount of information to control, direct, organize, coordinate, and to plan for the purpose of utilizing various physical and human resources so that the whole economic system can function orderly—hence avoiding redundant investments, redundant technology transfers, and redundant construction that have caused tremendous waste for China.

Second, information resources exploitation is conducive to solving and easing the limiting effects that the two large resources, materials and energy, impose on the Chinese economic development cause. China is a high material- and energy-consuming developing country, and materials and energy have thus become two important restrictive factors on Chinese economic development. Information resources based on knowledge and talent possess an accumulative nature, and are limitless in quantity. The development of the information industry has the following benefits: First, it reduces the waste of materials and energy, and increases their effective utilization rates; second, it gives full play to the effects of materials and energy, and allows energy to yield higher economic efficiency; and third, information resources *per se*, accompanied by economic and technological development, will continue to accumulate, are endless and limitless for use, and will incur no environmental costs like those that materials and energy resources have brought to mankind.

Third, developing information resources will fundamentally transform China's industrial structure, further elevating and solidifying the information resources' important position. The information industry encompasses the professional groups of manufacturing, assembling, processing, sorting, broadcasting, and information services. The information industry is gaining more and more weight in developed countries, with a tendency to surpass the First, Second, and Third Industries to become the most important one, the Fourth Industry. Developing the information industry will increase its share in economic returns, push the industry toward the direction of knowledge intensiveness and high added value. Meanwhile, it will boost the growth in the materials industry, marine industry, and biological engineering, and thus lead the integration of various professions into a new and compound professional system. It will also further reconstruct the traditional industries, and formulate a new information processing industrial system focusing on product end-user services. In the global economic arena, knowledge and capital intensiveness is rapidly replacing labor intensiveness, and intelligence is playing a more and more important role in economic activities. Promoting the information technology in China is an effective strategy for shortening the phase of labor intensiveness, and is a path toward modernization.

Fourth, developing the information industry can effectively elevate the intellectual level of the laborers, propelling economic growth. The exploitation and utilization of information resources is in fact an exploitation and utilization of intelligence. The higher the degree of exploitation and utilization of information resources, the faster the development of human intelligence. The existing physical resources can generate more returns if in the process of production information resources are more effectively exploited and utilized, and if the laborers' intelligence level is elevated to control and operate more manufacturing equipment, to save more materials, and to adopt new manufacturing technologies.

Fifth, developing the information industry is conducive to innovating traditional industries and speeding up industrial modernization. To orient China's economy to the path of relying on technological innovation, in addition to adopting many advanced technologies, the most practical and important strategy is to employ electronic information technology and to exploit information resources. Practical experience has demonstrated that the development of the information industry and the extensive utilization of electronic information technology are the important technological foundation for the development of China's energy, transportation, telecommunications, and raw materials industries, and the breeding ground for various high-technology industries, as well as the base for inspiring many new technologies, new manufacturing techniques, and new equipment that can generate progress and yield enormous economic benefits.

To exploit and utilize information resources, three problems need to be solved. The first is to make available the

needed information, a process of collecting the original information; the second is to obtain the available information in a given time, and this requires collective control over the many aspects of the information-conveying channels and technical equipment; and the third is to make sure the customers obtain the real needed information.

The starting point and growth base of the Chinese information industry lags considerably behind those of the developed countries. The industrial modernization on which the natural development of the information technology depends has not materialized. The development of the information industry lacks a solid foundation. To exploit information resources, China should start by tackling the three aforementioned factors and the three basic problems, absorb the advanced experience of some developed countries including Japan and the United States, and design appropriate strategies to exploit information resources according to China's basic conditions and capabilities as seen below:

First, design a nationwide complete promotional strategy, and establish the important strategic position of developing information technology. This development must be systematic, balanced, and mutually compatible. To develop and utilize the information resources, the State should plan and regulate on the macro level, avoid the decentralization and individualism of the national departments and the regional governments, and from a long-term perspective, elevate the development of information technology to a high strategic position.

Second, increase the awareness of information technology in the whole society. People are the major players in information resources development. To develop the information industry, China must change the people's perceptions, and increase awareness of the information technology. It is imperative that people realize the following facts: The development of a socialist market economy will eventually entail the production and exchange of information products; information services are also a productive activity; the information industry as the Fourth Industry is the most important one; the global propensity toward information technology is an inevitable trend of social evolution; and the exploitation and utilization of information resources have strategic significance for China's economic development and modernization drives. By the same token, the information industry can enlighten the people on the effects of information technology through its high-grade information products and services.

Third, develop information technology, and speed up the construction of the information industry and its promotion and applications. Information technology is the means for exploiting information resources, and thus must be improved in its many aspects including telecommunications materials, telecommunications equipment,

telecommunications technology, and computer information systems. Meanwhile, the construction and betterment of the information systems helps increase the productivity and the efficiency of developing the information technology.

Fourth, hasten the development of information services. The information services sector is an important component of the information industry, and is in fact the practical exploitation and utilization of the information resources. To speed the development of the information services sector, people must get rid of the notion that hardware is more important than software. China should focus more on software engineering and database services, enforce the construction of data communications networks, develop the appropriate technology for network value-added services, reduce the cost of telecommunications, and expand the markets. Additionally, the system assembly industry is currently advancing rapidly, and has acquired the second largest market next to software in the information services sector. China should closely watch the development trends of the global information industry, deliberately import advanced foreign technology and thus hasten the development of the related industries.

#### Measures To Readjust S&T Organizational Structure

93FE0568A Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 2, Mar 93 pp 31-34

[Article by Li Xingquan [2621 5281 2938] of the China S&T Promotion and Development Research Center]

[Text] In 1992 the State Science and Technology Commission proposed a policy of "strengthening one part of the S&T structure and opening up a new area" to guide Chinese government research organizations' plan of "personnel redirection and institution adjustment." In order to clearly define the target, mode and principle of adjustment, an overall design policy is needed.

#### I. Basis for Adjustment

##### 1. The Fundamental Premise and Origin of Adjustment: Practicing the Socialist Market Economy

The Chinese system of research organizations is the product of a long term planned economy system, its structure and layout are based on economic needs. The allocation and usage of S&T resources were centered around government departments. This was the root of many problems including fragmentation, lack of focus, repetition, and S&T research divorced from the economy and education. Although considerable efforts were put into S&T system reform, the situation was basically unchanged.

Practicing the market economy invariably leads to a diversification of interests, which in turn upsets the



situation of R&D institutes uniformly run by the government and diversifies the subjects that build research institutes. The open nature of a market economy will gradually break the old self-fulfilling and fragmented system and certainly broaden the division of work and collaboration between specialties. This complementary relationship between systems will make the whole function more effectively. The competitive nature of the market economy will improve the efficiency and effectiveness of R&D, make more rational allocation of S&T resources, more centralized S&T activities and form a network of research institutes.

Development of the market economy invariably brings along corresponding changes in government functions. "Unlimited power and unlimited responsibility" became limited power and responsibility. The power of economic management has declined but the power of public management has increased. The government will pay more attention to the macroscopic monitor but will no longer be directly involved in the microscopic process of economic interference and scientific research. The change of the government function and the increasing need of technology by the enterprises will make the research institutes established under the planned economy lose their basis for existence. Fundamental changes will gradually take place in the components of various systems, especially research institutes and enterprises under governmental jurisdiction.

Therefore, the basic premise and basis for structural adjustment in China's research organizations are the practice of market economy, changes in governmental functions, and the increase in enterprise vitality and vigor. These factors not only dictate the necessity and possibility of structural adjustment, but, together with economic development, also dictates the targets, modes and process of structural adjustment.

## 2. References for Readjustment

As basis and reference for our readjustment, we shall use the general principle and basic experience of R&D systems in developed countries under market economy, especially major developed countries. A review of the R&D systems in major developed countries revealed more commonality than individuality. There seems to be a general model:

(1) Government and industry are the major sponsors for R&D. The proportion of the government's share varies but is generally in the range of 20 percent (Japan) to 40 percent (West Germany) or 50 percent (United States, Great Britain, and France). In some developing nations, the government's contribution can be as high as 80 percent.

(2) The R&D systems in the world almost always consist of four components: government R&D organizations, industry, universities and non-profit R&D organizations. Among the four, industry is taking the lead and contributes 40 to 70 percent of the total R&D budget of a country. The received fund basically amounts to 60 to

75 percent of the corresponding total funding. Institutes of higher education, especially universities, are the main force in basic research. They receive their main support, 70 to 90 percent, from the government. This figure is as high as 98 percent in France. Government R&D organizations have their position but receive only about 10 to 30 percent of the total R&D money or 25 to 55 percent of the government funding. With the exception of 82 percent in Great Britain, the governments of other countries support 95 to 100 percent of their government R&D organizations. The non-profit R&D organizations have the smallest budget, usually about 3 to 4 percent of a country's R&D budget. The portion from the government is usually one-half or more than half, with the exception of Japan where it is 21 percent. There is always cooperation between the parts in the system, so the actual spending by universities and government R&D institutes is usually higher than the received funding.

(3) The R&D systems are supported by strong economies. R&D fundings are generally in the 2.2 to 2.9 percent range of the GNP (gross national production). R&D is characterized by a money intensive nature, for example, the per capita commitment of R&D personnel in the United States reached \$42,400 per person per annum in the late 1970's. In other countries this figure varies but within a factor of 3.

As the reform deepens and the economy develops, the societal environment in China is becoming increasingly ready to borrow the experience of developed nations.

## II. Final Goal and Specific Model for Readjustment

### 1. Final Goal of Readjustment

The final goal for readjusting China's R&D organization system is to establish an optimized, rational, vigorous R&D system that is compatible with the socialist market economy and the needs in economic and social development and is favorable to scientific and technological development and application.

### 2. Description of the Specific Model

The national R&D system consists of industry, government R&D institutes, colleges and universities, and civilian non-profit R&D organizations. In terms of funding contribution, the industry and the government each provide approximately 50 percent. In terms of funding allocation, the industry gets about 50 percent, the universities 15 to 20 percent, government R&D institutes 25 to 30 percent, and civilian non-profit organizations 5 percent or so. Industry is the main force in technological development and should gradually undergo a great development. As a R&D force, government institutes should reduce their total size and make it their main duty and mission to implement government assigned tasks. Institutes of higher education are a main base for basic research and should work with the Chinese Academy of Sciences to strive for high-level scientific achievements. Civilian R&D organizations should be a supplemental force in their pursuit of non-profit research. Overall, the industry should

take the lead and the three legs of the tripod should be the enterprise, the research institutes, and the universities. Each component should have its own emphasis which complements other components and cooperates with other components.

### 3. Layout of Government R&D Organizations

Government R&D organizations should be established on these two levels: central government and provincial level, autonomous region and municipality directly under the central government level. In principle, local city governments will not have R&D organizations. The central government and local government may run R&D institutes jointly and the legal form will resemble a "stockholding company."

R&D organizations of local governments should be different from the central government R&D organizations in terms of research level and should play a role mainly in areas of a local nature.

## III. Structural Readjustment of Independent Government R&D Organizations

### 1. Criteria for Establishing and Retaining Governmental R&D Organizations

The overall scale of R&D organizations directly started by the government will be reduced in the reform of economic system and administrative management system. The government will use the following criteria in retaining existing organizations or starting new ones.

- (1) Government duty criterion: The government will retain or start new R&D organizations that are essential to the discharge of the government's duty.
- (2) Non-market criterion: The realm of activity for government R&D organizations is in the area where the market is not a dominating factor.
- (3) The left-over criterion: The government will run those R&D organizations that are needed in the social development but the industry, universities, and other organizations are unwilling or unable to run.
- (4) The optimization criterion: The R&D organizations to be retained by the government should be the superior and unique ones among its peers.
- (5) Nonrepetitiveness criterion: In terms of research directions in government R&D organizations, they should in principle be nonrepetitive.
- (6) Economic ability criterion: The scale of government run R&D organizations should be within the economic means of the government.

Based on the above criteria, the specific areas for government R&D organizations include: basic science in certain areas, national security, materiel, resources, nuclear energy, space, ocean, precompetitive technology, fundamental technology, and generic technology, public welfare

and social security areas affecting people's health, and technologies for modernization in agriculture, forestry, and small business.

### 2. Estimates of R&D Organization Personnel in China

Assuming that China's GNP grows at a moderate speed of 8 percent per annum from the 1990 base level, then China's GNP in the year 2000 will be 3,756.49 billion yuan. If the national GERD (general expenditure in R&D) to GNP ratio in the year 2000 is 1.5 percent, then China's GERD in 2000 will be 56.35 billion yuan.

Based on foreign experience, the law of statistics, and China's level of economic development, we assume that one-half of GERD in 2000 is provided by the government. We further assume that, of the one-half provided by the government, one-half is used to "feed" government R&D organizations and the other half will be used to selectively support universities, industry, nonprofit R&D institutes, and other branching organizations via contracts and sponsoring agreements. Under these assumptions, the money available to "feed" government R&D organizations will be 14.09 billion yuan or \$2.35 billion (at a 6:1 exchange rate) and GERD in 2000 will be \$9.39 billion.

(1) Based on the average commitment of some Western countries in the late 1970's (\$79,300 per person per annum for R&D science and technology personnel, and \$35,400 per person per annum for all R&D personnel), China will have 119,000 R&D scientists and engineers, 265,000 R&D personnel nationwide, 30,000 government R&D scientists and engineers, and 66,000 government R&D personnel.

Based on the lowest commitment level in the West, in Yugoslavia, in the late 1970's (\$26,200 per person per annum for R&D science and technology personnel, and \$11,400 per person per annum for all R&D personnel), China will have 297,000 R&D scientists and engineers, 824,000 R&D personnel nationwide, 90,000 government R&D scientists and engineers, and 206,000 government R&D personnel.

(2) In 1990 there were about 1 million R&D workers in government R&D organizations of the county level and above, including 424,000 science and technology personnel. Assuming that the dozen largest State Council R&D organizations will "retain about one-third to one-fourth of their personnel and then reduce the number by one-third," there will be about 100,000 scientists and engineers left at the end.

(3) Although there were nominally 1 million R&D workers in 1990 in China's government R&D units, only 171,000 people were actually engaged in R&D projects, including 126,000 R&D science and technology personnel. Assuming that we take away the following from the 5077 R&D units in China: 1) organizations with no or essentially no government assignments, 2) organizations with no or essentially no R&D activity, 3) most "research institutes" started by local cities, 4) obvious

repetitive organizations, and 5) surplus personnel, then the remaining R&D scientists and engineers and R&D workers will be smaller than the commitment level in Yugoslavia in the late 1970's even with a certain annual growth figured in.

### 3. Strategies for Implementing the Readjustment

#### (1) Liberate Thinking and Implement the Openness Policy

The openness policy shall apply to organizations that continue to be under government administration or those that will branch out. While there is no guarantee that organizations needing stability can be stabilized and organizations needing liberation can be opened up, the first priority should be opening up. Directors of research institutes should be given sufficient autonomy. The direction opted by organizations that no longer take government money should be especially respected. Social welfare organizations should be given reform policies similar to those given to technology development organizations. Participation by the research institutes in "personnel re-direction" and "structural readjustment" should be highly encouraged without necessarily reducing the operating expenditure.

#### (2) Pay Attention to Institutes To Be Retained and Dissolved

In order to avoid indecision in the readjustment process, institutes should be carefully grouped and screened. Those that are hard to classify should be temporarily set aside and gradually dissolved in the process of carrying out current government projects and implementing the readjustment process.

#### (3) General Planning and Delegated Implementation

The readjustment goals set by the State Science and Technology Commission should be planned by the various departments and local governments. Their implementation should be carried out by organizations like the Commission of Science, Technology and Industry for National Defense, the Economy and Trade Office, the Ministry of Agriculture, the Ministry of Health, and the Chinese Academy of Sciences based on the administrative and organizational structures and function transformation process. On a local level, the implementation should be done by the provinces, autonomous regions, and municipalities directly under the central government based on the actual local situation and in the same spirit.

#### (4) Active Guidance and Independent Choice

Reform in personnel redirection and structural adjustment are even more complex, formidable, and involve more personal interests than the conversion of the operation mechanism; they must be carefully guided. Organizations undergoing the conversion process should be given the necessary assistance and 3 to 5 years of time to

make the transition. The incentive and independent nature of research institutes should be fully developed.

#### (5) Proceed at an Opportune Time To Ensure a Smooth Transition

In the 3 years after the Eighth 5-Year Plan, most of the activities were focused on testing to accumulate experience. In the first 3 years of the Ninth 5-Year Plan, the program moved forward with full force and basically completed the structural readjustment. The last 2 years of the Ninth 5-Year Plan were used to consolidate and perfect the readjustment results. This is a rough timetable, the final progress of readjustment must depend on the structural readjustment of the government system and function, the transformation of large and medium national enterprises, and the growth of the market system. Advances should be made at the opportune time so as to ensure a smooth transition.

#### China To Establish Large-Scale Productivity Promotion Center

93FE0615A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 15 Apr 93 p 1

[Article by Xu Jiling [1776 2623 3781]]

[Text] China will organize on a large scale the introduction of science and technology into business enterprises as a means of promoting technological advancement in business enterprises. The State Science and Technology Commission has started organizing and setting up throughout the country numerous Productivity Promotion Centers to provide a socialized and professionalized science and technology supportive framework to the nation's economic development.

Mr. Li Xu'e, deputy director of the State Science and Technology Commission, during the national working conference held in Nanjing on Productivity Promotion Centers, pointed out that setting up Productivity Promotion Centers is a new national means of intensifying the reform effort, and of promoting closer integration between science and technology and economic development. Its significance is no less than the "Torch Plan" or the "Spark Plan." He emphasized that the Productivity Promotion Centers are a new form of technological service organizations which cater directly to business enterprises, particularly township enterprises and small-to-medium business enterprises. Through consolidated packaged services such as human resources training, technical consultation services, enterprises diagnosis and technology development, the Productivity Promotion Center is expected to achieve the general objective of pushing forward technological advancements in business enterprises.

It was learned that Productivity Promotion Organizations are service organizations set up since the 1960's by various nations and regions in Asia with the objective of promoting productivity of small-to-medium business enterprises. Since the reform and the opening up to the outside



world, China has seen the prosperous development of small-to-medium business enterprises, particularly township enterprises. These enterprises have become an important force in the development of the national economy. However, these township enterprises have very weak technological strength and face tough competition in both domestic and international markets. Last August, the State Science and Technology Commission and the State Commission for Restructuring the Economy issued a joint statement on setting up Productivity Promotion Centers throughout the nation.

Now, Productivity Promotion Centers have been set up in 10 provinces/cities such as in Shandong, Liaoning, Jiangsu, Chengdu, Xi'an, Yichang, Taiyuan, Yueyang and also in mechanical and light industries. These Productivity Promotion Centers, under the guidance of the national macroeconomic policies, the national policies for industries and the national science and technology policies, focus on providing consolidated, packaged and comprehensive technological services to business enterprises. The Shandong Productivity Promotion Center last year provided over 1 million items of economic information of various types to business enterprises with significant economic and social effectiveness. The Mechanical Industry Productivity Promotion Center, in conjunction with Zhejiang Institute of Machinery, established an organization to promote the production line technology for forging resin particles and provided to business enterprises which used this technology full packaged services including the supply of raw materials, technical skills and production equipment. This makes possible the swift transfer of the latest forging technology to the production lines of various enterprises.

The Productivity Promotion Centers also open up new markets for science and technology personnel and research institutes and also effectively push technological services toward industrialization. The various Productivity Promotion Centers set up think tanks, enterprise registration databases, and products and information databases and bring the research institutes and the enterprises together and provide services in time. The Light Industry Productivity Promotion Center employs experts of various levels, various fields and experts with theoretical and practical experience to form a diagnostic team to diagnose and heal ailments of enterprises. Nineteen of the business enterprises which have been examined and diagnosed by the team have shown remarkable improvements in technical and management skills.

During the initial trial stages of the work, the various regions also emphasized the importance of setting up a network of Productivity Promotion Centers. In Jiangsu Province, a network of provincial, county and township promotion centers has been set up and has successfully extended various technical services to the grass-root

level, providing services directly to the small-to-medium enterprises and township enterprises.

In the working conference on the setting up of Productivity Promotion Centers which ended 13 April, it was pointed out that various regions must actively provide the conditions, and take various forms to set up Productivity Promotion Centers. Also, the various levels of Science and Technology Commission personnel should also intensify the study, guidance and management of the centers. Within a span of 3 to 5 years, a certain scale of development must be reached. Also, the objective is to raise the importance of technical advancement in small-to-medium and township enterprises by 5 to 10 percent of the profits.

#### **Chinese S&T Development Foundation Aims To Nurture Nobel Laureate**

93FE0615C Beijing JINGJI RIBAO [ECONOMIC DAILY] in Chinese 20 Apr 93 p 1

[Article by Guo Xiao [6753 2556] and Li Xiangnan [2621 0686 0589]]

[Text] The Chinese Science and Technology Development Foundation, formed 5 years ago of capital raised from the masses in the nation to promote the development of science and technology, has seen its capital rise from 3 million to 30 million yuan. Various professional societies throughout the country have established 50 special foundation funds under the auspices of the foundation. Now the foundation has become the country's largest civilian Science and Technology Foundation.

The predecessor of the Chinese Science and Technology Development Foundation is the Zhenhua (China Revitalization) Foundation of the Chinese Science Association, established in April 1988. Through various special funds, the foundation supported vigorously various science research activities. Examples are the Mao Yisheng Science and Technology Education Foundation, Sun Yueqi Science and Technology Education Foundation, Zhou Peiyuan International Science and Technology Exchange Foundation. These foundations have effects both within the country and also abroad. The International High School Student Olympic Award Foundation has presented prizes for 3 consecutive years to Chinese high school students who won awards in international competitions and contests and was well received by all. Up until now, the foundation has given financial support to 46 science research projects, 23 academic exchange activities, supported four kinds of journals and publications, published four volumes of books, and started 10 social events, awarded prizes to 603 outstanding science and technology personnel, with a total value of 10 million yuan. The objectives of the foundation are in the beginning of the next century to raise its capital to 100 million yuan and to nurture a group of Chinese Nobel laureates.

**Chinese Say AUSSAT-B2 Failure Not Fault of Long March Launch Vehicle**

93FE0710A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 6 May 93 p 1

[Article by Wang Hanlin [3769 5060 2651]]

[Text] In preparing for the final evaluation of the AUSSAT-B2 failure to be held in Beijing in mid-May for experts from the China Great Wall Industry Corporation and the Hughes Company of the United States, Chinese experts have made an overall review and analysis of the AUSSAT-B2 failure. The results showed that the explosion of AUSSAT-B2 destroyed the fairing but there was no doubt about the reliability of the Long March launch vehicle, according to Chief Designer of the Long March rocket Liu Zhusheng [0491 4554 3932].

Liu said that the day after the launch of AUSSAT-B2, the Chinese formed a failure analysis group headed by the general designer, Wang Dechen [3639 1795 5256], of the Long March launch vehicle. The group analyzed and evaluated the AUSSAT explosion from four different prospects. They double checked more than 400 remote sensing parameters and weather data in the launch of AUSSAT-B2 and compared their counterparts in the launch of AUSSAT-B1. The failure analysis center rechecked the design and test data of the rocket, especially data related to the fairing. They analyzed and compared the data to wind tunnel test results, aerodynamic dynamic coupling analysis, trajectory, load, and thermal coupling analysis, structural design, ground static tests, and whole rocket vibration analysis. They also traced the manufacturing, testing, and inspection data for the

fairing. In order to investigate the fracture mechanism of the failed fairing, the analysis group also performed a number of ground tests. All the analysis results showed that various systems of the rocket worked well before the satellite exploded, the weather conditions are within specifications and the rocket flight was normal. The fairing showed no sign of structural instability or honeycomb debonding. The fabrication was within specification and during the flight the rocket control system did not send error messages to the fairing separator. The failure of the fairing was entirely due to the high pressure produced by the explosion. It was therefore concluded that the cause of the AUSSAT-B2 explosion had nothing to do with the Long March rocket. On the contrary, the rocket overcame the strong interference of the satellite explosion and accurately delivered the remaining effective payload to the predetermined orbit. This showed that the performance of the Long March rocket was completely reliable.

According to Liu Zhusheng, China not only provided Hughes with data called for in the agreement, China also collaborated in the failure analysis, consented to the requests by Hughes and provided remote sensing data diskette and other data. These latter data were not called for in the original satellite/rocket interface control documents.

The final analysis report of the failure analysis group has passed the evaluation of an advisory group consisting of Fellows of the International Space Institute and the most famous rocket experts in China.

Finally, Liu told this reporter that it was extremely irresponsible for some foreign reporters to speculate or blame the satellite explosion on the Long March rocket.



## Two Ways of Extracting Propeller Recognition Features

93P60273A Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese Vol 18 No 3, May 93 pp 210-216

[Article by Wu Guoqing [0702 0948 3237], Wei Xuehuan [7614 1331 3883], and Zhou Gang [0719 6921] of the State Key Laboratory for Acoustics, Institute of Acoustics, CAS, Beijing 100080: "Two Ways of Extracting Propeller Recognition Features"; MS received 23 May 92, research supported by grant from NSFC]

[Abstract] An analysis of the radiated noise levels of vessels shows some strong superposed line components in low-frequency (below 100 Hz, especially from a few Hz to a few tens of Hz) spectrum occurring at discrete frequencies corresponding to propeller shaft rotation speed, propeller blade frequency, and the harmonics of both. The line components reflect the propeller's operating characteristics, so the propeller's features can be extracted directly from these line components. Another method for feature extraction is from the demodulated line component. Detection performance of the line component in background noise is discussed. The signal level is defined as the difference between the PDF (probability density function) mean of the line component peak and the PDF mean of the background noise. In the direct method, the signal level of the line component is proportional to the signal-to-noise ratio (S/N). In the demodulation method, the signal level of the demodulated line component decreases with decreasing S/N; signal level decreases slowly for high S/N and very fast for low S/N. These results are valuable for target recognition via long linear-array sonars and coastal-station sonars, and especially valuable for deep-sea long-range detection and recognition.

Figures 1-4 (not reproduced) show the low-frequency power spectrum (1a) and demodulated spectrum (1b) of radiated noise from ship A, the same plots for ship B, power spectral estimation of the detector output signal, and the PDFs with and without a signal, respectively. Figure 5 and Table 1 are reproduced below; the proportionality factor  $\alpha^2$  relates signal level  $H$  to the expression  $m_p^2 B/B_2$ , where  $m_p$  is peak modulation depth,  $B$  is bandwidth of the bandpass filter for the ship noise, and  $B_2$  is the bandwidth of the bandpass filter in the postposition spectral analyzer.

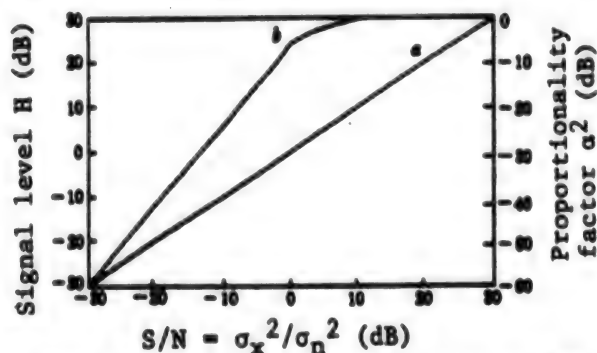


Figure 5. Relationship Between Signal Level and S/N

Table 1. Numerical Relationship Between Proportionality Factor  $\alpha^2$  and S/N  $\beta$

S/N $\beta$ (dB)	Prop. factor $\alpha^2$ (dB)	S/N $\beta$ (dB)	Prop. factor $\alpha^2$ (dB)
30	-0.0087	0	-6.0206
20	-0.0864	-1	-7.0780
10	-0.8279	-2	-8.2489
9	-1.0299	-3	-9.5287
8	-1.2778	-4	-10.9108
7	-1.5802	-5	-12.3866
6	-1.9465	-6	-13.9465
5	-2.3866	-7	-15.5802
4	-2.9108	-8	-17.2778
3	-3.5287	-9	-19.0299
2	-4.2489		
1	-5.0780		

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**Study on the Preparation and Properties of Self-Reinforced  $\text{SiC}_w/\text{Si}_3\text{N}_4$  Composites**

40100093A Beijing GUI SUANYAN XUEBAO  
[JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 21 No 1, Feb 93 pp 1-9

[English abstract of article by Song Shentai and Liu Guangzu of the Central Iron and Steel Research Institute, Ministry of Metallurgical Industry; MS received 30 Aug 91; research supported by grant from 863 Plan]

[Text] The growth conditions and mechanism of SiC whiskers synthesized by carbothermal reduction of silica are described. This method was used for preparing SiC whiskers which distributed homogeneously in the matrix of  $\text{Si}_3\text{N}_4$  powder, and then  $\text{Si}_3\text{N}_4$  composites with SiC whisker reinforcement were prepared. Since no additional whiskers are needed, this kind of materials may be referred to as "self-reinforced ceramic-based composites." These composites have good mechanical properties at 15%(vol)  $\text{SiC}_w/\text{K}_{\text{IC}} = 8.0 \text{ MPA}\cdot\text{m}^{1/2}$ ;  $\sigma(\text{b, RT}) = 649 \text{ MPa}$ ;  $\sigma(\text{b, } 1300^\circ\text{C}) = 621 \text{ MPa}$  (after oxidation at  $1300^\circ\text{C}$  for 100 h in air). The microstructural characteristics of  $\text{SiC}_w/\text{Si}_3\text{N}_4$  composites are: SiC whiskers are homogeneously distributed among  $\text{Si}_3\text{N}_4$  grains with nanometer-sized SiC particles trapped in the grains, only a few located on the grain boundaries.

**Studies on Gas Pressure Sintering of  $\text{SiC}_p/\text{Si}_3\text{N}_4$  Matrix Composite**

40100093B Beijing GUI SUANYAN XUEBAO  
[JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 21 No 1, Feb 93 pp 10-15

[English abstract of article by Chen Yuan and Huang Liping of the Shanghai Institute of Ceramics, CAS; MS received 23 Oct 91]

[Text] The relationship between the properties and microstructure of  $\text{SiC}_p/\text{Si}_3\text{N}_4$  matrix composite with  $\text{Al}_2\text{O}_3$  and  $\text{CeO}_2$  as additives prepared by gas pressure sintering (GPS) is investigated. The effects of SiC particle contents on fracture toughness, flexural strength, Rockwell hardness and microstructure of  $\text{SiC}_p/\text{Si}_3\text{N}_4$  composite are studied in detail. The results obtained show that addition of  $\text{SiC}_p$  in  $\text{Si}_3\text{N}_4$  suppresses the growth of  $\text{Si}_3\text{N}_4$  grains effectively, and the interface of SiC-SiC is quite different from that of SiC- $\text{Si}_3\text{N}_4$  in the composites. The maximum flexural strength of these composites with 30%(mass)  $\text{SiC}_p$  is 840 MPa, the maximum Rockwell hardness is 93.8 and the fracture toughness is  $5.8 \text{ MPa}\cdot\text{m}^{1/2}$ .

**Effect of Doping of  $\text{Al}_2\text{O}_3$  on Superconductivity of Bi-Based Glass-Ceramics**

40100093C Beijing GUI SUANYAN XUEBAO  
[JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 21 No 1, Feb 93 pp 54-59

[English abstract of article by Wang Kaitai, Fang Xiangyu, and Shen Dingkun of the Shanghai Institute of

Ceramics, CAS, and Lu Wengsheng and Zhou Shigui of the East China Institute of Chemical Technology; MS received 7 Dec 91]

[Text] Glasses of  $\text{Bi}_{1-x}\text{Pb}_x\text{Sr}_2\text{Ca}_3\text{Cu}_4\text{Al}_x\text{O}_y$  ( $x = 0-2.0$ ) are prepared by melt quenching method. The effects of doping amount of  $\text{Al}_2\text{O}_3$  on glass formation, technical properties, crystal phases, and superconductivity of Bi(Pb) SrCaCuO system are investigated by means of DTA, XRD, SEM and resistance measurement. The results indicate that in Bi-system glasses the glass-forming ability is enhanced and technical properties are improved by  $\text{Al}_2\text{O}_3$  doping. The formation of 2223 phase is not affected by suitable  $\text{Al}_2\text{O}_3$  doping amount. The superconducting phase is needle-like crystal. Some glass fibers are drawn from glass precursor with  $x = 1.5$ , and the critical temperature  $T_{\text{C, zero}}$  after heat treatment is 104K. These results are helpful to the manufacture of superconducting fiber by means of glass-ceramics.

**As-S Infrared Glass Optical Fiber With a Core-Cladding Structure**

40100093D Beijing GUI SUANYAN XUEBAO  
[JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 21 No 1, Feb 93 pp 66-69

[English abstract of article by Yang Kewu, Wu Peilan, and Wei Guosheng of the Beijing Glass Research Institute; MS received 24 Feb 92]

[Text] A new fiber-drawing apparatus with a double crucible made of hardness glass and an argon-gas pressure control system have been designed. Using this apparatus, As-S or other chalcogenide glass fibers of different diameters and different core-to-clad ratios can be drawn. Fiber with numerical aperture of 0.5 and transmission loss of 1.32 dB/m at 2.4-micron wavelength is obtained when the composition of core and clad glasses of fiber is  $\text{As}_{38}\text{S}_{62}$  and  $\text{As}_{35}\text{S}_{65}$ , respectively. It is also shown that the loss of such fiber is lower than that of the unclad fiber.

**Ultrafine AlN Powder Synthesized by Chemical Vapor Deposition Technique**

40100093E Beijing GUI SUANYAN XUEBAO  
[JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 21 No 1, Feb 93 pp 93-99

[English abstract of article by Li Chunzhong, Hu Liming, Chen Minheng, Zhu Yuanzheng, and Cheng Xiaoming of the Technical Chemico-Physical Laboratory, East China Institute of Chemical Technology; MS received 3 Jul 91]

[Text] Ultrafine AlN powder is synthesized by chemical vapor deposition of anhydrous  $\text{AlCl}_3$  and  $\text{NH}_3$  at  $700-1000^\circ\text{C}$ . It is found that the shape of AlN particles varies with temperature and the ratio of  $[\text{NH}_3]/[\text{AlCl}_3]$ , and that the particle size and distribution of width decrease with increasing temperature and total flow rate and with

decreasing  $\text{AlCl}_3$  concentration. The content of crystalline AlN in the product increases with increase of reaction temperature. The by-product,  $\text{NH}_4\text{Cl}$ , which coexists with amorphous AlN, is easily eliminated by heating at  $600^\circ\text{C}$ . Amorphous AlN can be changed into crystalline AlN at  $1450^\circ\text{C}$  with particle size less than 250 nm; a geometric standard deviation (GSD) less than 1.3; content of nitrogen greater than 33.5 percent; and content of oxygen, chlorine and metallics less than 1.0 percent, 0.1 percent,  $1.5 \times 10^{-2}$  percent, respectively.

### **Zhang Ze: Pioneer in Materials Science**

40100092A Beijing CHINA DAILY in English  
18 Jun 93 p 5

[Article by Li Xing]

[Text] Award winning scientist Zhang Ze is a pioneer in investigating properties of some special alloys.

His work is in the field of materials science, which is at the cutting edge of new technological developments.

The importance of the research in material science was summarized in an issue of SCIENTIFIC AMERICAN in the following way.

"Advanced materials are essential to the future growth of the aerospace, electronic device, automobile and other industries.

"Progress in materials science sets ultimate limits on the rate at which key sectors of the economy can grow."

Zhang, 40, is a research professor at Beijing Laboratory of Electron Microscopy (BLEM), a division of the Chinese Academy of Sciences.

His success has been in the discovery and analysis of properties in a number of new alloys under electron microscopy.

His work has received much recognition. He was one of six to win the first national "Young Chinese Scientist Awards" earlier this year.

He was one of 14 earlier this year who received young scientist research grants from China National Natural Science Foundation.

Zhang has enjoyed various awards and honours since 1987 when he was awarded the top National Science Prize. In that year, he was a chief member of a BLEM research team.

Zhang made a major breakthrough in 1984 with the help of his advisor Guo Kexin (Kuo Ke Hsin), a leading Chinese physicist and director of BLEM.

They discovered a titanium-nickel-vanadium alloy whose atomic structure had a symmetry that had been considered impossible in such solid matters as metals and common alloys.

Symmetrical atomic structures were previously believed to exist only in crystalline materials such as gold and silver.

There are only two types of symmetry in crystal structures, Zhang explained.

One resembles the square or hexagon tiles paved in lines and rows on a bathroom floor. The scientific term for this is a periodic translational symmetry.

The other structure is like laying square and hexagon floor tiles in a bathroom around a tile as an axis; as work progresses, the tiles at the centre increase from two, three, four and six-fold.

This is called a rotational symmetry with the axis changing from two, three, four and six-fold.

"The apparent five-fold rotational symmetry and non-periodic translational symmetry show that the atomic structure of the titanium-nickel-vanadium alloy is different from that of normal crystals," he said.

Their independent findings were a benchmark in the history of solid state physics. The findings corresponded to an earlier discovery in the same year by Israeli metallurgist Denis Shechtman and his co-workers of an aluminum-magnesium alloy.

This had similar "forbidden symmetries," as leading international physicist Paul J. Steinhardt described in the May 1989 issue of SCIENTIST magazine.

The discoveries by Zhang and others have in the following years helped rewrite the century-old dictum on solid-state physics.

The existence of a brand new group of solid matters, called pseudo- or quasi-crystals, were recognized and further explored.

All these endeavours were part of an international search for new materials.

### **Defects**

Meanwhile, Zhang and Guo continued to investigate the quasi-crystal to explain the relationships between quasi-crystal alloys and crystalline materials.

They came up with some basic points about quasi-crystals. These led to the discovery of around 10 other new such alloys.

Zhang's work led him to become one of the pioneering scientists in the world to find "defects" in quasi-crystals, the flaws being in the symmetrical atomic structures.

He made this major discovery while he was doing research as a guest scientist of the Research Centre of Germany in Juelich.

His key work started a new area of studies in finding out more about defects in quasi-crystals.

Leading German physicist professor Knut Urban praised Zhang's research and said it was on a par with the discovery of flaws in crystals after World War II; this was a discovery that led to the development of a series of new theories and materials processing techniques.

Born and brought up in Tianjin, Zhang wasn't a science wizard when he was a teenager. His junior middle school years came during the chaotic "cultural revolution" (1966-1976) when science and learning were largely abandoned.

After graduation, he was picked out as "a youth for re-education" and moved to a village in Northeast China.

He worked hard there and won the support and confidence of the village peasants and cadres. In 1977, they sent him to study at Jilin University.

"It was during those years that I realized learning was very very important," he recalled.

He soon developed a keen interest in the properties of things.

"I felt the need to find out what it is that makes up things," he said.

During his years of graduate studies toward masters and Ph.D degrees, Zhang said he was very influenced by Guo Kexin who supported his work.

Guo made the point to Zhang that in the international scientific arena there is a Number One who makes the discovery; but there is not a Number Two.

In addition to his earlier honours, Zhang has been promoted deputy-director of BLEM.

The organization since 1984 has been listed as one of the top 20 laboratories for scientific research in China, largely due to its pioneering studies in quasi-crystals.

Zhang has been kept busy with many chores apart from research, such as filling in forms to raise funds for laboratory projects, and getting housing and food subsidies for graduate students now working at the laboratory.

"I benefited from a period during my college years when science and learning was highly respected," he said.

"But today, money-worship is so wide-spread that it has drawn a lot of talented young people away from scientific research.

"What I am trying to do during the better part of my day's work is maintain a better working environment for the young scientists at the lab."

As far as his research is concerned, he said he was trying to explore a number of new areas.

Using electron microscopes, he is currently summarizing his observations and studies on the growth mechanism of diamond films.

This is research that may lead to a series of important applications in semi-conductors and other industries.

He has also begun another project looking into the atomic properties of carbon-60, one of the hot subjects of research in today's scientific drive for new materials.

"After all, I have studied quasi-crystals for nearly 10 years," he said. "Now I need a change and the chance to find out about something completely new."



**Genetic Engineering Pharmaceutical Base Built in Shenzhen**93P60276C Beijing RENMIN RIBAO OVERSEAS  
EDITION in Chinese 27 May 93 p 3

[Article by Liu Xiao [0491 7197]]

[Summary] The Kexing [4430 5281] Biological Products Company, Ltd., was recently established in Shenzhen to attract foreign capital. Kexing Co. is China's first pharmaceutical company designed for large-scale production of genetically engineered pharmaceuticals. Major products of phase I production will be the State Category I new drugs such as human  $\alpha 1$  genetically engineered interferon, a Chinese-developed interferon obtained from normal leukocyte genes.

**Genetically Engineered Insulin**93P60276B Beijing RENMIN RIBAO OVERSEAS  
EDITION in Chinese 3 Jun 93 p 1

[Article by Li Jinghua [2621 0079 5478]]

[Summary] By using *E. coli* system, a new technique to produce genetically engineered insulin has been developed by Tang Jianguo [0781 1696 0948], associate professor of Biology Department of Beijing University. Self-constructed plasmid was used to express the encoded human proinsulin gene in *E. coli* to produce human insulin. According to Tang Jianguo, the low-cost, easy-to-conduct technique can be used to produce massive amount of insulin, which has much the same physical structure and chemical nature as human insulin. The new drug is likely to replace insulin extracted from animals or synthetically produced.

**New Diagnostic Method for Epidemic Hemorrhagic Fever**93P60279A Beijing YIYAO XINXI LUNTAN [CHINA  
MEDICAL TRIBUNE] in Chinese 29 Apr 93 p 7

[Article by Lin Limin [2651 7812 3046]]

[Summary] A new method to quickly diagnose epidemic hemorrhagic fever (EHF) has been developed by Fang Liang [2455 0081], a Xi'an Medical University professor. The method requires only 1-2 drops of the patient's blood and takes only 5-10 minutes. To do the test, one puts a drop of the immune serum, which was obtained from patients in the EHF recovery stage, on top of the tested patient's serum. If the patient is EHF positive, in 5-10 minutes a white ring will appear on the contact surface of the two sera. Having been used on 100 patients by Professor Fang, the method was proven to be simple and sensitive. The method has a 100 percent positive incidence if it is used before the fourth day of the onset of EHF, a 25 percent positive incidence if used in the transition stage, and a 16 percent positive incidence in the polyuria and recovery stage. In the first two days of onset, the antigen can be tested in patient's blood and urine with

a titer higher than 1:500. Because of its high sensitivity and easy access of the materials it uses, the method can be conveniently used in any EHF epidemic area.

**Purification and Anticancer Activity of Cytotoxin-14 From Venom of *Naja naja atra***40091012A Shanghai ZHONGGUO YAOLI XUEBAO  
[ACTA PHARMACOLOGICA SINICA] in Chinese  
Vol 14 No 3, May 93 pp 279-282

[English abstract of article by Zhong Xiaoyan [0112 2556 3601] of the National Institute of Pharmaceutical Research and Development, Beijing; Liu Guangfen [0491 1639 5358] and Wang Qingchuan [3769 2532 1557] of the Laboratory of Venom Research, Fujian Medical College, Fuzhou]

[Text] Ion-chromatography of lyophilized cobra (*Naja naja atra*) venom on SP-Sephadex C-50 yielded 14 fractions, of which 7, 8, 9, and 10 possessed neurotoxic actions and 11, 12, 13, and 14 had cytotoxic activities. Chromatography of fraction 14 on SP-Sephadex C-25 gave cytotoxin-14. It was homogeneous on polyacrylamide gel electrophoresis with  $m = 7448$  Da. It was a typical cytotoxin without phospholipase  $A_2$  activity and had a selective cytotoxic action on human cancer cell lines.

Key words: cytotoxins; neurotoxins; cobra venoms; chromatography; cultured tumor cells; polyacrylamide gel electrophoresis

**Preparation and Selective Cytotoxic Activity of Antihuman T Lymphocyte Momordins Immunotoxins**40091012B Beijing ZHONGHUA WEISHENGWUXUE  
HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF  
MICROBIOLOGY AND IMMUNOLOGY] in Chinese  
Vol 13 No 2, Apr 93 pp 74-77

[English abstract of article by Wang Runhua [3769 3387 5478], Zheng Shuo [6774 4311] et al. of the Institute of Basic Medical Sciences, Academy of Military Medical Sciences, Beijing]

[Text] The ribosome-inactivating proteins, momordin 1 and momordin 2, isolated from the seeds of *Momordica charantia*, inhibited protein synthesis potentially in rabbit reticulocyte lysate, the concentrations of inhibiting 50 percent (IC<sub>50</sub>) of protein synthesis were 14 nmol/L and 0.15 nmol/L, respectively. When the momordins were targeted to murine monoclonal antibody that recognized human T lymphocyte CD5, the resulted conjugates H65-MOR 1 and H65-MOR 2, showed potent cytotoxic activity to target Molt-4 cells, but not to nontarget Daudi cells. The IC<sub>50</sub> of H65-MOR 1 and MOR 2 were 8 nmol/L and 6 nmol/L respectively as assessed by MTT cleavage assay. The H65-MOR 2 immunotoxins also showed marked cytotoxicity to target human peripheral blood T lymphocytes with an IC<sub>50</sub> (the concentration inhibiting 50 percent of DNA synthesis)



of 4.5 nmol/L as estimated by measuring the inhibition of DNA synthesis in response to mitogen. At the concentration of  $10^{-8}$  mol/L, the H65-MOR 2 immunotoxin killed 3.3 log (> 99.9 percent) of Molt-4 cells as assessed by clonogenic assay, but had no effect on human hematopoietic cells as evaluated by granulomonocytic colony-forming cell (CFU-GM) assay. Further, momordins immunotoxin made from an antibody (N34) of irrelevant specificity had no effect on Molt-4 cells and T lymphocytes. We consider that the momordins immunotoxins could be used for T lymphocyte purging in allogeneic bone marrow transplantation.

**Application of the Fusion Proteins Containing Core and NS3 Fragments of HCV Expressed by Recombinant Escherichia Coli**

40091012C Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 13 No 2, Apr 93 pp 101-105

[English abstract of article by Tan Deming [6223 1795 2494] of the Department of Infectious Diseases, The First Affiliated Hospital, Hunan Medical University, Changsha, China, Terukatsu Arima of the Second Department of Internal Medicine, Faculty of Medicine, Kagoshima University, Kagoshima, Japan, et al.]

[Text] Fragments of core and NS3 of HCV-Hun were cloned by RT-PCR and gene recombinant techniques from blood samples collected in Hunan Province. In comparison with sequences of the lab's samples with those of HCV-US and HCV-J, the homologies of nucleotides and amino acids were about 90 percent, indicating that fragments of core and NS3 of HCV-Hun were in relatively conserved region of HCV. The two fusion proteins containing the peptides encoded by HCV.core (MBP-HCV.core) and HCV-NS3 (MBP-HCV.NS3-Gal) were synthesized by Escherichia coli with recombinant plasmids. The specific HCV antigenicity of those two fusion proteins were identified by western blotting. The results of western blotting assay and ELISA for anti-HCV showed that MBP-HCV.core and MBP-HCV.NS3-Gal were useful in anti-HCV assay either by western blotting or ELISA.

**Specific Combining of Recombinant C3 Fragment Expressed in E. Coli With Complement Receptor 3 (CR3)**

40091012D Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 13 No 2, Apr 93 pp 115-117

[English abstract of article by Ma Dalong [7456 1129 7893], Zhou Baohong [0719 1405 1347], et al. of the Department of Immunology, Beijing Medical University]

[Text] Using genetic engineering technique the lab expressed a recombinant fragment of human C3  $\alpha$  chain,

namely C3-2SE. The FITC labelled or Sepharose 4B immobilized C3-2SE could bind specifically to the CR3 on human or mouse cells. The results confirmed Wright's C3 binding site studies for CR3 and supplied a new way to research the CR3 on molecular level.

Key words: Human complement C3; CR3; CD11b/CD18; Genetic engineering

**Expression of Rabies Virus Glycoprotein With Vaccinia Virus Tiantan Strain**

40091012E Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 13 No 2, Apr 93 pp 118-120

[English abstract of article by Cai Bing [5591 0365] of the Wuhan Institute of Biological Products, Ministry of Public Health, PRC, Joseph Esposito of the Centers for Disease Control, Atlanta, USA, et al.]

[Text] Using the promoter of late 11K protein (P11) from Tiantan strain vaccinia virus (VV), the chimeric plasmid pTK11KRG was constructed to express CVS rabies virus glycoprotein gene in VV TK locus. Chicken embryo fibroblast cells were transfected with pTK11KRG plasmid and VV Tiantan strain by lipofectin and the recombinant virus TTV11KRG was constructed. The recombinant can express the glycoprotein efficiently and the Western blot showed one specific band of about 64 kD. When inoculated into mice, the recombinant can elicit neutralizing antibody against CVS rabies virus, with the MNT (mouse neutralizing test) titers of 324 in 7 days and 810 in 14 days, and protect them against the attack of 36 LD<sub>50</sub> of rabies virus.

**Studies on the Fusion Breeding of Flocculent Yeasts for Beer Manufacturing**

40091011A Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 33 No 1, Feb 93 pp 22-31

[English abstract of article by Jiang Huixiu [3068 1979 0208], Zhang Jinling [1728 6855 3781], Zhou Jian [0719 1017], et al. of the Institute of Microbiology, Academia Sinica, Beijing]

[Text] Five flocculent brewery yeast fusants were obtained by protoplast fusion method. The fusants were obtained from a strain of *Saccharomyces carlsbergensis* A43 and a respiratory deficient petites of *S. carlsbergensis* B8 with erythromycin-resistant property. The latter is a Burns Value Test negative non-flocculent brewing yeast. The fusants F6, F7 acquired the flocculent capacity as its parent A43 and retained the industrial fermentative merit of another parent strain B8.

The cell DNA content determination of the fusants showed their ploidies are 2n, 3n and 4n respectively. The cell surface hydrophobicity has been determined by

Octyl-sepharose CL-4B hydrophobic interaction chromatography. The results showed A43 and all of the fusants as well displayed stronger hydrophobic property than their parent strain B8. And the cell hydrophobicity is in accordance with their flocculence intensity.

#### Screening of Inosine-Producing Strain by Protoplast Fusion

40091011B Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 33 No 1, Feb 93 pp 74-78

[English abstract of article by Wang Yuewu [3769 1471 0063], Zhang Bei [1728 5563], and Zhou Yuliang [0719 5280 5328] of the Department of Biology, Nankai University, Tianjin]

[Text] Taking *Bacillus subtilis* 7171-9-1 as starting strain, mutants N<sub>33</sub> (Ade<sup>-</sup> + Xan<sup>-</sup> + SG<sup>+</sup>) and N<sub>168</sub> (Ade<sup>-</sup> + His<sup>-</sup> + 8 - AG<sup>+</sup>) are obtained after 60 minutes by mutagenic treatment with 1 percent DES. Using N<sub>33</sub> and N<sub>168</sub> as parents, a higher inosine productivity of F22 is gained by protoplast fusion technique. The optimum conditions of protoplast's preparation and regeneration have been determined. Under these conditions, the forming rate and the regeneration rate of the protoplasts of N<sub>33</sub> and N<sub>168</sub> are 94.7 percent and 20.9 percent, 91.7 percent and 24.4 percent, respectively. The fusion rate of protoplast is  $5.4 \times 10^{-4}$ . The best conditions of flask-shaking fermentation for F22 have also been determined and level of its inosine accumulation is 24.58 g/l. F22 has been found to be comparatively stable after 10 generations in flask-shaking, therefore, it has a higher potential value of application.

Key words: Protoplast; Fusion; Inosine; Fermentation

#### Redirecting Medical Equipment Industry's Development Strategy Following GATT Renewal

93FE0622A Beijing JIAN KANG BAO in Chinese 2 Apr 93 p 2

[Article by Shen Jianlei [3088 1696 7191], Department of Science and Technology, State Pharmaceutical Administration: "Strategy for China's Medical Apparatus and Instrument Industries Development Following GATT Renewal"]

[Text] Based on market economy and free competition, the General Agreement on Tariffs and Trade (GATT) provides a system for action to promote multilateral trade. After the GATT renewal, China is privileged with equal competition in the international market but at the same time obliged with "import tariffs reduction" and "non-tariff barrier reduction or elimination." Undoubtedly, the renewal will seriously affect China's young medical apparatus and instrument (MAI) industries.

The development of modern MAI tends to move in the direction of high technically added values, and the

crisscrossing of multiple disciplines and hi-tech. However, China's high-tech product fields are still in the beginning stage. Especially, the production levels of electronic instruments and large-scale precision apparatuses lag behind those of the industrially developed countries by 15-30 years. After the GATT renewal, foreign hi-tech products can not only enter the Chinese market in large quantity, but also sell at highly competitive prices. Consequently, they will seriously impact China's budding MAI industries, in particular the infant high-tech industries. China's MAI industries have been developed as labor intensive industries and small scale businesses for some time. Most MAI industries are small, independently managed entities. They have never been systematically structured on the basis of division by specialty. Moreover, lacking investment, production methods become outdated, and equipment, antiquated. As a result, products are not upgraded. The low-efficiency and inferior quality of the products make it even harder to compete with foreign products. Due to the above, China's MAI industries must clearly recognize the current situation, develop countermeasures, and meet the challenge.

1. The key to accelerate MAI industry's modernization is making high new-tech developments the leading force to upgrade product and improve technology. Many of China's high new-tech areas have superior basic research levels and abundant personnel resources, able to speed up R&D adjustments and changes; to establish a development system linking production, research, technical engineering, and marketing; as well as to reinforce independent developments of new products and new technology. Thus, the industrialization of science and technology achievements will speed up product reform.

2. The organizational adjustment of MAI industries must be accelerated. Investment in technological reform must be increased. Combining self-initiated unified adjustment and macro-coordination, a new industrial structure of division of labor by specialties and large-scale production management will gradually emerge. The MAI industries should strive to join the international ranks of work specializations.

3. An open-minded course of science and technology development must be followed. The tradition of territorial division and closed system should be abolished. Technical exchange and cooperation among trades should be enforced. And the introduction and cooperation of foreign technology should also be emphasized.

4. Through mandatory implementation of GMP standards for MAI and thorough enforcement of Series ISO-9000 standard, the quality management and quality assurance system of China's MAI industry will be established and perfected. Setting quality assurance as the main goal, we must correct the situation that China, having the technology to manufacture, is unable to assure MAI quality and competitiveness. We must strive so that China's good-quality and low-price MAI products can compete in both domestic and international markets.

The GATT renewal will speed up MAI industry modernization to compete internationally; stimulate its product revolution and its technological development. Moreover, there is a 3-5 year transition period before the GATT renewal date. China is confident of the opportunity, and the possibility of grasping the favorable circumstances to meet the challenges.

### Progress in Industrialization of Biotechnology

93FE0622B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 5 Apr 93 pp 1-2

[Article by Hou Yunde [0186 0061 1795], chief scientist in "863" Biotechnology Domain: "Develop Biological High-Tech; Promote Industrialization"]

[Excerpts] [Passage omitted] Current biotechnology study in China consists of three major projects and one special project as follows:

1. Animals and plants that have high yield, superior quality, and are adversity resistant.
2. New pharmaceuticals and vaccines, and gene therapies.
3. Protein engineering.

The special project is rice genome mapping.

The general plans are arranged as follows: taking the increase of food production in the first project as the strategic focal point; using the second project as a strategic breakthrough to develop China's biotechnology and to realize high, new-tech industrialization in order to promote nationwide biotechnology; and making the third project and the special project technical strategic reserves to establish a foothold in the even greater biotechnological development of the next century.

For over 6 years since the implementation of the "863 Plan," China's biotechnological accomplishments have been recognized internationally. In addition to China's leading position of rice hybridization, the research of transgenic plants, test-tube calves, and gene therapy of hemophilia have reached advanced international level. High, new-tech pharmaceuticals such as genetically-engineered (GE) interferon, GE hepatitis B vaccine, and human interleukin-2, have certain competitiveness in the international high, new-tech market. Among which, human  $\alpha$ 1b GE interferon was first developed in China. Even more important, due to the promotion and spread of the "863 Plan," biological high, new-tech is now considerably popular in China. Especially in agricultural molecular biology, numerous superb laboratories have been established and many brilliant young science and technology personnel have been trained.

We believe that one important aspect of the biotechnological gap between China and the other nations is product development. From now on, strategically the main goal in biotechnology is to realize modern high-tech industrialization, which is a major target of our efforts.

### II. Key to Industrialization Is To Emphasize and Reinforce R&D

[Passage omitted] As early as during the "Seventh 5-Year Plan," three joint research and development (R&D) centers were established for the second project. The purpose is to unify research-development-industrialized production in the shortest time possible, utilizing as its basis the existing manpower and equipment, as well as assisted with high, new-tech and small capital by the "863 Plan."

These three joint R&D centers are: the Joint R&D Center for GE Vaccine, affiliated with the Changchun Institute of Biological Products; the Joint R&D Center for GE Pharmaceuticals, affiliated with the Shanghai Institute of Biological Products; and the Joint R&D Center for GE Biological Products, affiliated with the Shanghai Institute of Medical Industry. Their missions are the research, development, and pilot production of these target products: hepatitis B vaccine, interferon, and interleukin-2, respectively. In each joint R&D center, the production unit is the "locomotive" which unites with related higher agencies to form a consolidated product development body. Up to now, these three centers have a contingent of 200 science and technology personnel specifically capable of biological high-tech research, as well as coordinated development and production.

This arrangement is a brave experiment of the Expert Committee. Its purpose is to bridge the gap between laboratory research and production in order that China can establish its biological high-tech industries at top speed with minimum investment under the current condition and to surpass the advanced international standards. In the last 6 years, in spite of some management problems, the joint R&D centers have definitely accelerated the development of science and technology results. Up to now, all of the four GE high-tech products that have obtained the State Certificates for new pharmaceuticals and are introduced in the market are originated from the three Joint R&D Centers. Among these products, the GE vaccine for hepatitis B and GE interferon were completed owing to the continuous endeavor of the "Sixth 5-Year Plan" and the "Seventh 5-Year Plan."

At present, a great number of high and new technologies (which are pending further research and development) will be transferred from the laboratory to the market. The three Joint R&D Centers are far from being able to accommodate the new demands, therefore China has made an important system reform. The Department of Development of High New-Tech Products was established under the Bio-Engineering Development Center of the State Science and Technology Commission. Under the "863 Plan," after laboratory research, the results have to be evaluated by experts; then under unified management, the development department conducts developmental research further jointly with sub-agencies in the framework of market economy. The "863 Plan" invests a small amount of capital to commence the



intermediate development research, and the production unit bears the major expenses. Upon completion of the intermediate research, the product is released into the market. Its profit will be distributed among all the participating organizations. We believe that the adaptation and promotion of a product can be greatly accelerated when the product is introduced into market economy in the product's intermediate research stage. Furthermore, 15 different high, new-tech vaccines and pharmaceuticals are currently in the intermediate testing or clinical testing stage. China's biological high, new-tech industry is now gradually taking shape.

### III. Promotion and Transfer of High-Tech Achievements Have Made Substantive Progress

The medical high, new-tech products in biotechnology have achieved substantive progress. Four products have been introduced into the market. Currently, 15 products are in the intermediate developmental stage. [passage omitted]

At present, three different GE interferons have obtained the State Certificates for new pharmaceuticals and are marketed. They are: human GE interferon  $\alpha 1b$  for external use, human GE interferon  $\alpha 1b$  for injection, and human GE interferon  $\alpha 2a$  for injection. Interferons can treat more than 30 viral diseases, or malignant tumors. These interferons are the first batch of state-licensed and marketed high, new-tech pharmaceuticals. China is the first and only country that produced the human GE  $\alpha 1b$  interferon in the world market. Compared with other similar pharmaceuticals, it has lower side effect and technically meets the advanced international standard. It is now produced by four plants, among which, the Kexing Biotechnology Company, Ltd. in Shenzhen is the most progressively equipped and the largest modernized factory in China. From laboratory research to the market, the investment in GE interferon amounted to over 30 million yuan: over 3 million yuan for laboratory research; and about 30 million yuan for intermediate research which includes factory modification, equipment and instrument purchasing, and clinical testing. Nevertheless, after 6 months of production, the company recovered about 60 million yuan, or a profit of over 20 million yuan. Evidently, there are substantial economic benefits from the high, new-tech products.

[Passage omitted] The success of the genetic engineering hepatitis B vaccine generates not only monetary profit but also the inestimable social benefit of controlling the hepatitis B epidemic for generations to come. [passage

omitted] The GE hepatitis B vaccine is the first high, new-tech vaccine licensed to market by the state. It meets the advanced international standards in more than 20 indices. At present, its production has been transferred to five biological-product research institutes in China. Several Third World countries have cooperated with China for technical transfer, or product imports.

The marketing of high, new-tech GE interferons and vaccine for hepatitis B not only introduced the nucleus products of China's biotechnology industry, heralding the formation of China's biological high, new-tech industry, but also reflects China's international position in modern biotechnology.

### Profile of Sichuan Sida Biotechnology Company 93P60276A Chengdu SICHUAN RIBAO in Chinese 13 Apr 93 p 1

[Article by Xu Hong [1776 5725]]

[Summary] Located in the Chengdu high and new-tech development zone, the Sida [0934 6671] Pilot Testing Pharmaceutical Plant was co-established in 1988 by the Sichuan Sida Biotechnology Industrial Development Co., Ltd. and the Sichuan Emei Salt Industry & Chemical Company, Ltd. The new company is to promote industrialization and commercialization of a series of products listed in the company's development agenda, which are products obtained from human urine and animal blood, plants and green food products, and biochemical and microbial genetic engineering products. Since 1988, Sida Company has started its large-scale production of HCG (human chorionic gonadotropin), SOD (superoxide dismutase), papain, myo-inositol, UTI (trypsin inhibitory factor), and EGF (epidermal growth factor). Large-scale production of SOD extracted from swine blood has expanded from Sichuan to Wenjiang [3306 3068], Mingshan [0682 1472], and Mianyang [4875 7122], and podophyllotoxin for venereal disease and skin disease treatment developed by Sida will be put on the market soon. The company's laboratory has also developed pure taxinol that is now urgently needed by the 800,000 tumor and cancer patients in the United States. Medicinal tea bags and green food products are also being put on the market. All these high-tech products will bring to the company an even bigger economic profit in the future. From 1988 to 1992, Sida Company's assets grew from 200,000 yuan to more than 14 million yuan, an increase of 70 times.

**Chinese University of HK Buys U.S.-Made Supercomputer**

93P60269A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 19 May 93 p 29

[Article by Tang Baoxing [3282 1405 5281]: "Chinese University of Hong Kong Purchases Supercomputer"]

[Text] The Chinese University of Hong Kong, with a subsidy from Hong Kong's British government, has installed a DEC supercomputer. This supercomputer, model DECmpp 12000, is a massively parallel processing system. Since the machine will be used by an educational institution, DEC has lowered the price from HK\$12 million to HK\$4.5 million.

The first research application for this supercomputer is the development of an intelligent Chinese-language full-text search system. The research group will consist of eight persons, including Chinese University of HK professors and students, DEC engineers, and scholars from the mainland. The research itself includes application of artificial intelligence technology to the comprehension of Chinese natural language structures.

Specialists from the University of Hong Kong, Hong Kong Polytechnic, and other Hong Kong institutions of higher learning will also conduct research with this computer.

**COCOM Controls Said To Hinder DEC's Development of Chinese Market**

93P60284B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 20, 26 May 93 p 1

[Article by Li Liangyu [2621 5328 3768]: "COCOM Controls Hinder DEC's Development in China"]

[Summary] DEC Asia Regional Governor Edmund Reilly remarked to a Reuters reporter the other day that COCOM controls are still suppressing the pace of DEC's development of Chinese business and ability to keep in step with Chinese economic growth. Reilly estimated that, as of the end of his firm's fiscal year (30 June), DEC's revenues in China would experience only a 10 percent growth rate, approaching the minimum for his firm in the Asia Region. DEC's revenue growth rate in India has reached 111 percent, and the firm's average growth rate for Asia is 25 percent. Among the firm's gross revenues of US\$14 billion, Asia only accounts for US\$500 million. As an example of the difficulties still posed by COCOM controls, Reilly noted that the U.S. Department of Commerce must issue an export approval for each of DEC's new Alpha chips going to China, and DEC's newest product line—including the 200 MHz workstation series unveiled this month [i.e., May]—is heavily built around these new chips.

**CDC/nCUBE Holds MPP Forum in Beijing**

93P60284C Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 20, 26 May 93 p 5

[Article by Li Liangyu [2621 5328 3768]: "CDC/nCUBE Jointly Hold MPP Forum"; cf. JPRS-CST-93-003, 2 Mar 93 p 23]

[Summary] The U.S. commercial alliance CDC/nCUBE—consisting of massively parallel processor (MPP) manufacturer nCUBE and its sales representative CDC Asia—held an MPP forum in Beijing a few days ago. nCUBE, a major MPP maker with 350 systems installed worldwide, recently reached agreement with CDC Asia whereby the latter would be the former's exclusive Asia-Pacific-region sales representative for the nCUBE 2 parallel processing computer system. With regard to whether nCUBE's MPP computers can enter the China market, a U.S. Embassy commercial affairs official described the U.S. and COCOM's export controls situation and policy with respect to China. This official noted that controls on 286 and 386 machines had already been lifted, and that with the end of the Cold War, controls are being more and more loosened. With reference to nCUBE, this means that MPPs with fewer than 30 CPUs will usually be exportable to China, while for MPPs with over 30 CPUs, more detailed information on the user will be required and the specific circumstances will be examined—only after this strict examination will a final decision be made. Brazil and China are both subject to similar controls, but the maximum number of CPUs [in an MPP system] that Brazil can now import is 128.

**Additional Details on CEMT-III Chinese-English S&T-Materials MTS**

93P60284E Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21, 2 Jun 93 p 1

[Article by Ji Maoyuan [0370 5399 6678]: "CEMT-III Chinese-English Machine Translation System Achieves New Breakthrough"]

[Editorial Report] Additional details not already provided in an earlier report on the CEMT-III Chinese-English S&T-materials machine translation system (MTS) jointly developed by the Harbin Institute of Technology Computer Department and by the Chinese Academy of Launch-Vehicle Technology (CALT) Institute 103 [see JPRS-CST-93-011, 14 Jun 93 p 21] are as follows: This new MTS, which passed formal technical appraisal the other day, is programmed with 1500 general-purpose rules and 2100 specialized rules. System performance testing demonstrates that translation accuracy is 78 percent for a restricted set of language materials [fengbi yu liao] and 67 percent for other materials. When run on a 386/33 PC, the system's average translation time is 15 seconds per sentence.



### Shenzhen Firm Sets Up Nationwide Chinese-Language WINDOWS Alliance

93P60284A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 20, 26 May 93 p 1

[Article by Liu Jiuru [0491 0046 1172] and Guo Xiujuan [0948 4423 1227]: "Xinbo Co. Proposes Establishment of Chinese-Language WINDOWS Alliance"]

[Summary] The Shenzhen Xinbo [2450 3134] High-Tech Co. has proposed the formation of a Chinese-language WINDOWS alliance among all domestic computer software development firms in order to standardize input methods, character-base interfaces and applications programs, as well as to avoid wasteful and repetitious development: all so that the nation's software industry can keep pace with the latest international trends. Xinbo Asst. General Manager Xu Haixun [1776 3189 6061] announced a few days ago that Xinbo had reached agreement on these principles with the Stone Group, Legend Group, Beida Fangzheng [0554 1129 2455 2973 (Beijing University Beida Upright Group)], and other major firms. Xinbo has already developed the "Mengbi ['Dream Pen'] Document" software, a typesetting software system developed under the brand-new double-byte Chinese-language WINDOWS environment. This software uses an internationally standardized graphical user interface, mouse, and Chinese menus.

### Microsoft Introduces Windows NT to China

93P60284D Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21, 2 Jun 93 p 1

[Article by Li Liangyu [2621 5328 3768]: "Microsoft Formally Markets Windows NT"]

[Summary] On 24 May, the Microsoft Corp. formally unveiled Windows NT on its home soil in the United States, and only 5 days later—on 29 May in Beijing—

formally introduced this new product to a broad spectrum of Chinese users. Windows NT is Microsoft's new-generation PC operating system designed to run applications programs under different hardware support environments and to handle various packet network information. It is designed for 32-bit Intel CPU and Sun SPARC systems, as well as future new-generation microprocessors.

### Real-Time Speaker-Dependent Syllable Recognition System for the Complete Vocabulary of Chinese

40100090A Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese Vol 18 No 3, May 93 pp 161-171

[English abstract of article by Chen Tao, Li Changli, and Mo Fuyuan of the Institute of Acoustics, CAS, Beijing; MS received 30 Jan 92; research supported by grant from NSFC]

[Text] Based on a large number of speech experiments, Mandarin speech recognition approaches have been thoroughly studied, and a real-time speaker-dependent all-syllable recognition system of Mandarin has been developed on an IBM PC/AT microcomputer with a high-speed digital signal processing board TMS320C25-E. In accordance with the phonetic characteristics of Mandarin, the three-stage recognition strategy is adopted in this system. Experiments for the speech data of 4 times 1240 syllables show that: average correct rate of four-tone recognition is about 99 percent, correct rates of the first five candidates of syllable recognition are 82 percent, 91 percent, 94 percent, 96 percent, and 97 percent respectively, and the whole system response time is less than 0.2 second. In addition, the Mandarin initials and finals confusion matrices and the corresponding hierarchical clustering diagram of the similarity are obtained from the experimental results; they are analyzed in comparison with references [1,2] so as to further improve the system performance.

### Cerenkov FEL Certified at USTND

93P60280A Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 24 May 93 p 3

[Article by Li Wei [2621 1792]: "Cerenkov Free Electron Laser Certified"]

[Summary] The Cerenkov free electron laser (FEL) developed over a 4-year period as a State Laser Technology priority project by scientists at the University of Science and Technology for National Defense (USTND, also known as Changsha Institute of Technology) passed appraisal a few days ago at USTND. Laser experts have appraised this FEL as meeting late-eighties international standards for such devices. The USTND research group, led by Prof. Li Chuanlu [2621 0278 5251], first succeeded in obtaining Cerenkov FEL light output in 1990, and has spent the past 2-plus years in refining the technology. The relativistic electron beam in the FEL provides a high-power, tunable coherent radiation source with applications in defense, industry (such as in metal surface machining), and biotechnology and medicine.

### High-Power, High-Repetition-Rate Femtosecond Optical Pulse Amplifier

93FE0570A Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 13 No 3, Mar 93 pp 199-203

[Article by Zhang Ruobing [4545 5387 0393], Zhang Weili [1728 0251 0500], Zhou Naixu [0719 0035 1645], and Wang Qingyue [3769 3237 2588] of the Department of Precision Instrument Engineering, Tianjin University: "High-Power, High-Repetition-Rate Femtosecond Optical Pulse Amplifier"; supported by the Key Doctoral Fund, MS received 25 Jun 91, revised 2 Jan 92]

#### [Text] Abstract

70 fs, 2.4  $\mu$ J low-dispersion optical pulses have been obtained from a colliding-pulse mode-locked dye-laser amplifier pumped by a copper vapor laser. The repetition frequency of the pulses is 5 kHz.

#### 1. Introduction

In 1981, Fork et al. produced 90 femtosecond (fs) pulses by means of colliding-pulse mode-locking (CPM) for the first time with a ring dye laser at Bell Labs. Since then, fs optical pulses have been used in the study of ultrafast phenomena in various disciplines.<sup>1</sup>

Different CPM schemes are employed to amplify optical pulses for different applications.<sup>2</sup> A copper vapor laser (CVL)-pumped CPM dye laser amplifier not only has a high peak power, but also a high repetition rate. It has a wide range of applications. In May 1990, Rodenberger et al. obtained 0.3  $\mu$ J low-dispersion 63-73-fs optical pulses using a CVL-pumped amplifier at the University of Pennsylvania.<sup>3</sup> These optical pulses can be directly used in ultra-continuous-spectrum experiments without the need for compression outside the cavity resonator. In this paper, effects of pumping power, CVL pulsewidth, dye concentration and

spontaneous amplification on the amplification process of the CVL-pumped fs dye-laser amplifier are systematically studied. Pulses of 2.4  $\mu$ J in energy, 70 fs in pulsewidth and 5 kHz in repetition rate have been obtained.

#### 2. Description of Experiment

The experimental setup is shown in Figure 1, in which fs pulses are produced by a CPM dye laser.<sup>4</sup> The dye laser has a six-mirror ring resonator that is 3 m in length. It is pumped by an Ar<sup>+</sup> laser along its length. The radii of curvature for mirrors  $M_1$ ,  $M_2$  and  $M_3$  are 5 cm and that for  $M_4$  is 2 cm. The radius of curvature for  $M_5$  is 2 m.  $M_6$  is a planar mirror with a 2 percent transmittance. It has been proven, both theoretically and experimentally, that a large-radius-of-curvature ring resonator is highly stable.<sup>5</sup>  $M_4$  is a dual-film dielectric mirror. It produces a negative dispersion to offset the positive chirp generated by the self-phase modulation caused by the flow of the dye in order to obtain a narrower pulsewidth.<sup>4</sup> The pulsewidth of the fs pulses generated by the CPM laser is 65 fs, center wavelength is 614 nm, and the energy per pulse is 0.2 nJ; repetition rate is 100 MHz.

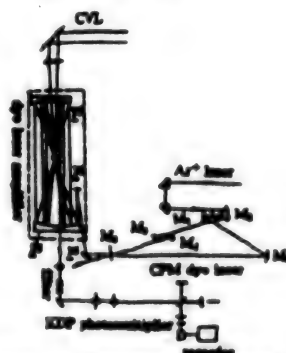


Figure 1. Amplifier for Femtosecond Optical Pulses Pumped by a Copper Vapor Laser at 5-kHz Pulse Repetition Rate

The pumping source for the amplifier is a 40-mm-diameter CVL with a 2-m-long cavity. Its pulsewidth is 35 ns. The pulse repetition rate is tunable between 3 and 5 kHz. Because the pumping pulsewidth is too wide, amplification of fs optical pulses becomes extremely difficult. This issue will be discussed in detail later. In this work, an extended cavity technique is used to effectively compress the pulsewidth and improve the divergence angle. Figure 2 shows the structure of the resonator.

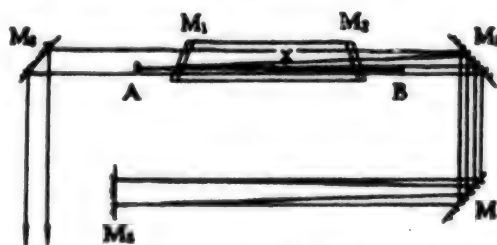


Figure 2. Resonator Configuration of Copper Vapor Laser With Compression of CVL Pulsewidth

The CVL employs an external resonator structure.  $M_1$  and  $M_2$  are made of planar quartz. They are positioned at a small relative angle. A and B are small flat mirrors;  $M_3$ ,  $M_4$ ,  $M_5$  and  $M_6$  are planar mirrors. Radiation emitted from a point x near the copper block is transmitted along the line of sight to B and then is reflected to A. From A, it is reflected to  $M_3$ ,  $M_4$  and  $M_5$ . It is reflected back into the resonator from  $M_5$ . Since CVL is self-terminating, when the pulse reenters the resonator from  $M_5$ , because there are more particles at the lower energy level, only the leading edge of the pulse is amplified and the trailing edge is absorbed. Thus, the pulse is compressed. Figures 3 (a) and (b) [photographs not reproduced] show the CVL pulse waveform before and after compression. It is 35 ns wide before and 10 ns after. Therefore, when pumping pulses tunable at a repetition rate of 3-5 kHz and pulsewidth of 10-35 ns, mean output power of 5-10 W can be obtained with this extended resonator technique.

Multi-pass dye lasers usually employ one of the following two mechanisms: separate optical elements<sup>6,7</sup> or multiple reflection with two or three mirrors.<sup>3,8</sup> The latter is used in this work. The amplifier is a confocal system comprised of two mirror systems of different radii of curvature, as shown in Figure 1. Our calculations show that as the number of amplification cycles increases, the light spot at the focus of the amplification medium also grows. During its sixth pass through the medium, the spot is three times the size as that when it passes the medium for the first time. This helps curb the gain saturation effect during amplification.

The amplifying dye is Kiton red 620 at a concentration of  $1.0 \times 10^{-3}$  M in ethanol. The thickness of the dye is 1 mm. From Figure 1, we know that the fs pulses delivered by the CPM dye laser go through  $R_1$  and  $R_2$  to enter a confocal system comprised of  $R_3$  and  $R_4$ . They are amplified by passing through the dye several times. The CVL pumping light is focused at the amplifying medium through a hole in the center of  $R_4$  by a lens. Amplified fs pulses exit from a hole in  $R_3$ . The pulses pass through an interference filter, a neutral density filter and a small grating before entering a measurement system. From the figure, the amplifier achieves amplification by passing the CPM optical pulses through the dye six times during the duration of a pumping pulse. Our calculations show that this amplifier, even when the mean pumping power is a few watts, can achieve population inversion saturation within 2 ns. Therefore, multi-pass amplification for the duration of the pumping pulse can effectively utilize the pumping power to result in a high amplification gain with low pumping power.

### 3. Experimental Results and Discussion

Experimentally, it is demonstrated that pumping power, pulsewidth of the optical pumping pulse, dye concentration and amplified spontaneous emission (ASE) have a significant impact on the gain of the amplifier. The results are as follows.

#### 3.1 Copper Vapor Laser and Its Pulsewidth

The repetition frequency of the fs pulses emitted by the CPM dye laser is 100 MHz and the interval between pulses

is 10 ns. The pulsewidth of the CVL prior to compression is 35 ns. During the amplification process, there are at least three CPM pulses within the width of a CVL pulse. These pulses are amplified to different degrees. Consequently, an imbalanced pulse series is produced, as shown in Figure 4 (a) [photograph not reproduced]. After tuning the CVL to compress its pulsewidth to 10 ns, the amplified fs pulse, as shown in Figure 4 (b) [photograph not reproduced], is a single pulse. The gain is raised by 100 percent. To this end, in order to obtain an ideal result, the CVL pulsewidth ought to be held below 10 ns.

#### 3.2 CVL Pumping Power

Figure 5 shows the gain as a function of pumping power. Curves I, II and III correspond to Kiton red 620 dye concentrations  $1.0 \times 10^{-3}$  M,  $1.41 \times 10^{-3}$  M and  $1.86 \times 10^{-3}$  M, respectively. There are some common characteristics. The gain rises with increasing pumping power. When the pumping power reaches a certain level, the gain saturates. This is because at a certain dye concentration the number of inverted particles saturates as the pumping power increases. The equation for inverted particles during pumping is:

$$\Delta n(t) = \frac{nW_p\tau}{1 + W_p\tau} [1 - e^{-(1+W_p\tau)t}], \quad (1)$$

where  $W_p$  is the pumping rate,  $\tau$  is the upper energy level lifetime of the gain medium and  $n$  is the particle density of the gain medium. As we mentioned earlier, at a certain optical power, equilibrium of inverted particle density can be reached within a very short period of time (less than 2 ns). From the equation above, the density of inverted particles at equilibrium is:

$$\Delta \bar{n}(t) = \frac{nW_p\tau}{1 + W_p\tau}. \quad (2)$$

Curve IV in Figure 5 shows how  $\Delta \bar{n}(t)$  varies with pumping power when the Kiton red 620 concentration is  $1.41 \times 10^{-3}$  M. The curve shows that the inverted particle density approaches saturation as pumping power increases.

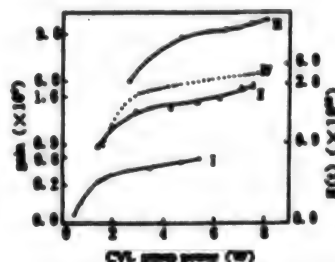


Figure 5. Amplifier Gain as a Function of Pump Power for Three Different Concentrations of Kiton Red 620: I— $1.0 \times 10^{-3}$  M; II— $1.41 \times 10^{-3}$  M; III— $1.86 \times 10^{-3}$  M. The calculated dependence of  $\Delta \bar{n}(t)$  on pump power for Kiton red 620 concentration of  $1.41 \times 10^{-3}$  M is shown by the dotted line.

### 3.3 Dye Concentration

From Figure 5, it is clear that the gain is significantly increased as the dye concentration rises. Figure 6 shows the gain versus dye concentration plot at a pumping power of 5 W. As the dye concentration increases from  $1.0 \times 10^{-3}$  M to  $1.86 \times 10^{-3}$  M, the energy of the fs pulse goes up by an order of magnitude. If the dye concentration continues to rise, there is no significant increase in pulse energy; it is saturated. This is because the number of particles that can be pumped to the upper level is limited by the pumping power. On one hand, with increasing concentration,  $\Delta n$  also rises and ASE becomes more intense as well; this drives  $\Delta n$  to approach equilibrium. On the other hand, since the amplifying medium has a finite thickness, when the dye concentration is high, the pumping light is strongly absorbed by the medium on the side near the pumping laser. The medium on the other side cannot receive sufficient pumping. It has a lower gain or even becomes an absorbing medium to adversely affect the gain.

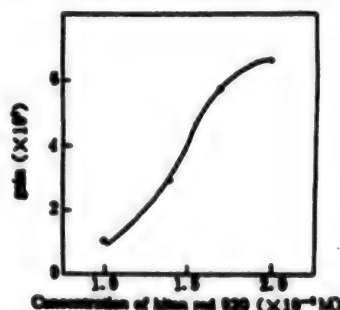


Figure 6. Amplifier Gain as a Function of Concentration of Kiton Red 620

### 3.4 Amplified Spontaneous Emission

When the CVL pulsewidth is 10 ns, output power is 5 W, pulse repetition rate is 5 kHz and diameter of optical spot on the amplifying dye is 1 mm, the peak power density at the focus is  $12.7 \text{ MW/cm}^2$ . Such a high power density produces an intense ASE. ASE not only consumes upper energy level particles to lower the gain but also produces an extremely bright background for the fs pulses. Therefore, ASE must be suppressed in the experiment.

In our initial experiment, it was found that a confocal spherical amplifier exhibits a stronger ASE than a discrete element amplifier. A connected yellow spot found on the confocal mirror repeatedly passed the dye which adversely affected the gain of the amplifier. Because the ASE spectrum is wider and shifted toward the yellow compared to that of the fs pulses, and also because its directivity is poor, an aperture diaphragm and an interference filter were added to the optical path to effectively suppress ASE.

Figure 1 shows the co-linear optical correlator used for correlation measurements in this work. The thickness of the KDP crystal is less than 1 mm. The results show that

low-dispersion 70-fs optical pulses with an energy of  $2.4 \mu\text{J}$  have been obtained. Figure 7 shows the autocorrelation curve.

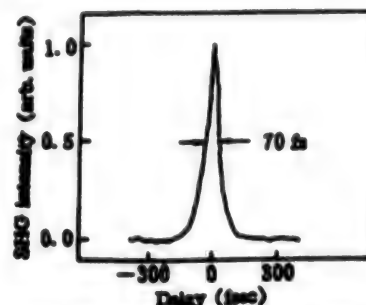


Figure 7. Autocorrelation Trace of the Amplifier Output Pulses

By changing the dye, solvent and medium thickness, reducing various losses in the optical path, and effectively suppressing ASE further, it will be possible to obtain fs optical pulses with an energy of several dozen microjoules in the future.

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### Image Matching Based on Optical XOR Logic Operation

93FE0570B Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 13 No 3, Mar 93 pp 244-247

[Article by Zhang Jiajun [1728 1367 6511], Zhang Li [1728 5461], and He Anzhi [6320 1344 0037] of the Department of Applied Physics, East China Institute of Technology, Nanjing; "Image Matching Based on Optical XOR Logic Operation"; MS received 10 Dec 91, revised 29 May 92]

#### [Text] Abstract

A novel image-matching method based on optical logic operation is presented. If optical XOR [exclusive OR] operations are performed between an input image and every stored image, and the sum of transmitted light intensity of each logic operation is obtained optoelectronically, then the best match to the input image is the image corresponding to the minimum transmitted light intensity. An optoelectronic system that employs polarization code and multi-imaging technique has been constructed and has produced experimental results.

#### 1. Introduction

Finding the optimal match between an input image and a series of stored images is an extremely important technology in areas such as pattern recognition, target tracking, industrial inspection and robot vision. Various optical methods such as filter matching<sup>1</sup> have been proposed to implement this technology. An optical neural network<sup>2</sup> may also be used to solve this problem. Recently, J. Singh<sup>3</sup> proposed a new method to optically compare the positive of the input image to the negatives of stored images and to simultaneously compare the negative of the input image to the positives of stored images. The best match is determined by the minimum transmitted light intensity collected. In his method, a double comparison is necessary. Furthermore, the input image must be duplicated  $M$  times (where  $M$  is the number of stored images).

A novel approach based on an optical logic operation is presented in this paper. As is well known, an optical logic operation is a nonlinear process based on an optical computation and optical image treatment. The authors have proposed an optical logic operation to extract specific Moire patterns.<sup>4,5</sup> From the optical logic viewpoint, the double comparison done by J. Singh is effectively an "XOR" operation. Despite there being numerous methods to implement an optical logic operation, for the sake of simplicity, a polarization code method has been employed. In order to avoid duplicating the input image, a multi-imaging technique is adopted.

#### 2. Principle of Image Matching Based on Logic Operation

The similarity,  $S$ , between two  $N \times N$  binary images is defined as follows:

$$S = \frac{\sum_{i=1}^N \sum_{j=1}^N a_{ij}}{N^2}, \quad (1)$$

where  $a_{ij}$  is either 0 or 1. When the values of the two images at point  $(i,j)$  are identical,  $a_{ij} = 1$ ; otherwise,  $a_{ij} = 0$ .

Obviously,  $S = 1$  indicates that the two images are identical and  $S = 0$  represents the case where the two images are complementary. In general, the larger  $S$  is, the more similar the two images are. Usually, a binary logic operation can be expressed by a  $2 \times 2$  true value.

As shown in the figure below, the input variables are  $a$  and  $b$  and the output logic variables are  $C_1$ ,  $C_2$ ,  $C_3$  and  $C_4$ . Therefore, a logic operation involving  $a$  and  $b$ ,  $L(a,b)$ , can be expressed as:

$$L(a,b) = C_1 \bar{a} \bar{b} + C_2 \bar{a} b + C_3 a \bar{b} + C_4 a b. \quad (2)$$

		$a$	
		0	1
$b$	0	$C_1$	$C_2$
	1	$C_3$	$C_4$

For instance, when  $C_1 = C_2 = C_3 = 0$ , and  $C_4 = 1$ ,  $L(a,b)$  represents a "AND"  $b$ .

If a logic operation is performed for all the points of two binary  $N \times N$  images, i.e.,  $A(a_{ij})$  and  $B(b_{ij})$ , then the sum of the output from all points is:

$$P = \sum_{i=1}^N \sum_{j=1}^N (C_1 \bar{a}_{ij} \bar{b}_{ij} + C_2 \bar{a}_{ij} b_{ij} + C_3 a_{ij} \bar{b}_{ij} + C_4 a_{ij} b_{ij}). \quad (3)$$

For an "XOR" operation,  $C_1 = C_4 = 0$ ,  $C_2 = C_3 = 1$ . Therefore,

$$P = \sum_{i=1}^N \sum_{j=1}^N (a_{ij} \bar{b}_{ij} + \bar{a}_{ij} b_{ij}). \quad (4)$$

By definition, it is easy to derive the following equation:

$$n_{ij} = 1 - (a_{ij} \bar{b}_{ij} + \bar{a}_{ij} b_{ij}) \quad (5)$$

Hence, the similarity equation can also be expressed as follows:

$$S = 1 - (P/N^2) \quad (6)$$

Equation (6) indicates that  $P$  can also be used to judge the similarity between two images: for  $0 \leq P \leq N^2$ , the smaller  $P$  is the more similar the two images become. In order to determine the value of  $P$ , two physical processes can be used to describe the mathematical process

expressed by equation (4). The "XOR" operation between the two images can be performed point-by-point optically first. Then, the sum of the results of these logic operations can be obtained optically as well by collecting transmitted light with lenses. The weaker the transmitted light is, the more similar the two images become. Therefore, we have an image-matching method based on optical "XOR" logic. The "XOR" operation is carried out between input image and all stored images and the sum of the point-by-point logic operations is obtained optically by measuring the total transmitted light intensity. The best match to the input image is the stored image corresponding to the minimum transmitted light intensity.

In theory, it is also possible to employ the equivalence (i.e., exclusive "NOR" or "XNOR") logic operation ( $C_1 = C_4 = 1$ ,  $C_2 = C_3 = 0$ ) to implement image matching. In this case,

$$P' = \sum_{i=1}^N \sum_{j=1}^N (a_{ij}b_{ij} + a_{ij}b_{ij}), \quad (7)$$

$$S = (P' / N^2) \quad (8)$$

The transmitted light intensity after performing an "XNOR" operation between the input image and each stored image is obtained. The best match corresponds to the maximum transmitted light intensity. However, it is easier to find the minimum, rather than the maximum, optoelectronically. Hence, there is more interest in image-matching methods that are based on the optical "XOR" logic operation.

### 3. Polarization Coding and Incoherent Multi-Imaging System

An image is comprised of a number of pixels over a fixed area. So-called polarization coding makes pixels of a certain value have a specific polarization pattern in order to code the input image and stored images with linearly polarized light. The coding scheme for the input image is shown in Figure 1(a). Pixels with a value of 1 are polarized vertically and pixels with a value of 0 are polarized horizontally. Since the coding schemes for the two images that are involved in the logic operation are usually correlated and the input image is coded according to the scheme shown in Figure 1(a), then all the stored images should be coded using the scheme shown in Figure 1(b). Using such code schemes, pixels of different values between the input image and stored image will have the same polarization state. Pixels of the same values, however, will have orthogonal polarization states. Therefore, in theory, the "XOR" logic operation between two images can be realized by overlapping the coded input image and stored image and shining natural light through them.

In the following simple proof-of-principle experiment, the polarization coding pattern of the binary image was made by sticking polarization films prepared based on the image structure. If a more detailed polarization pattern is required, it is preferable to start with a

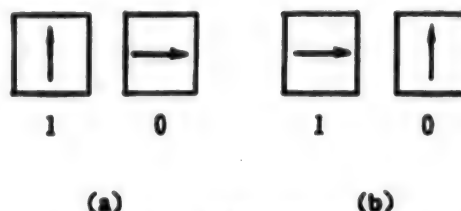


Figure 1. Coding Schemes

vectorgraph, coat its two sides with positive and negative photoresist, and then expose it with the image to be coded. After processing, the required polarization coding pattern can be obtained.<sup>6,7</sup>

Based on the image-matching principle described above, the input image has to be compared with every stored image. The best match is the minimum of these  $M$  comparisons. In order to finish  $M$  comparisons in one attempt without the need to duplicate the input image, an incoherent multi-imaging system was employed. As shown in Figure 2,  $S$ , an incoherent light source, and  $D$ , a diffuser, form a uniform planar light source;  $I$  is the coded input image;  $M$  is the memory mask in which all stored images are held after being coded; and  $L_1$  is a lens array. By properly adjusting  $L_1$ , the input image can be imaged on every stored image.  $L_2$  is used to image the lens array onto the detector array PD. Then, the light intensity received by each detector represents the sum of the point-by-point "XOR" result between the input image and a specific stored image:

$$I_n = I_0 \sum_{i=1}^N \sum_{j=1}^N (a_{ij}b_{ij}^{(n)} + a_{ij}b_{ij}^{(n)}), \quad (9)$$

where  $I_0$  is the incident light intensity at each pixel and  $b_{ij}^{(m)}$  is the pixel value at point  $(i,j)$  of the  $m$ th stored image.

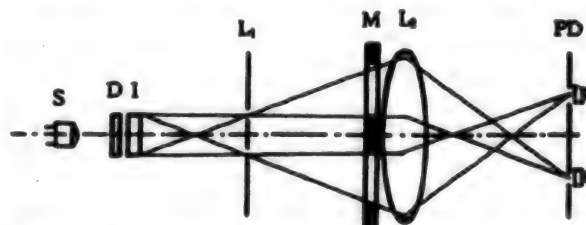


Figure 2. Incoherent Multi-Imaging System for Image Matching

### 4. Experiment

In order to verify the proposed method, several proof-of-principle experiments have been performed. Figure 3 shows an example. Figure 3(a) shows four images stored in a memory mask. (They are the letters A, M, E and R.) Images were coded according to the scheme shown in Figure 1(b). The input image is shown in Figure 3(b) and it was coded according to the scheme shown in Figure 1(a). The matching process was done using a system

shown in Figure 2. In this experiment, a  $2 \times 2$  pinhole array (diameter 0.7 mm and spacing 3 mm) was used instead of the lens array,  $L_1$ . The focal length of the collecting lens  $L_2$  is  $f = 150$  mm. In order to provide an intuitive comparison, Figure 3(c) shows the direct "XOR" results between the input image and stored images. Naturally, "A" is most like itself and most dislike "M." Figure 3(d) shows the results of the implementation of this method. It is a distribution of transmitted light intensity received by the detector array. Each spot should be circular. However, because the quality of the collecting lens is less than perfect, each spot shows a "comet's tail." Among the four output spots, the upper left one is the darkest; it is almost black. This indicates that the stored image on the upper left corner is the best match for the input image. This conclusion is apparently correct.

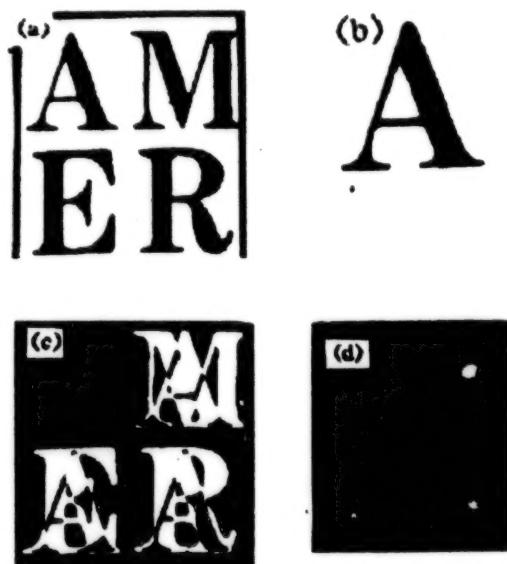


Figure 3. (a) Memory mask storing four letters; (b) Input image; (c) Results of XOR logic operation of input image with each stored image; (d) Collected light intensity distribution on the detector plane

## 5. Discussion

The method presented has an important feature, i.e., the best match is determined without the need to measure any absolute output values. Instead, it only requires determining the relative minimum. Hence, it is insensitive to transmission noise of the system. Furthermore, it has some tolerance to minute changes caused by factors such as dimension, rotation and displacement. Nevertheless, there is one fact that cannot be ignored: at a given incident light intensity, a certain light intensity,  $I_{\min}$ , can still be transmitted through two overlapping orthogonal polarization plates. This is the sensitivity threshold of this method.

In theory, this method can also be expanded to process gray-scale images. For instance, it is possible to correspond each gray value to a polarization direction, and to make the angle between the direction of polarization and the horizontal axis increase with the gray scale, and to ensure that the states of polarization of pixels of identical value between the input image and stored images are orthogonal after they are coded. Therefore, after coding in a system such as the one shown in Figure 2, the best match to the input image corresponds to the minimum output. Moreover, other coding schemes such as  $\theta$  modulation<sup>4,8</sup> can also be employed to implement the "XOR" logic operation optically.

In conclusion, a method to determine the best match for an input image using optical logic operations is presented. As a special example, polarization coding is used to implement the logic operation. Furthermore, a multi-imaging technique is used to avoid duplicating the input image. It should be pointed out that the emphasis in this paper is on introducing the principle of this new technique. Consequently, issues such as the light source and optoelectronic detection threshold are omitted in the discussion.

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**High-Quality Ti:Sapphire Tunable Laser Crystal  
Developed by SIOFM**

93P60280B Shanghai WEN HUI BAO in Chinese  
1 Jun 93 p 3

[Article by Qiao Jingwen [0829 2529 2429]: "Ti:Sapphire Laser Crystal Research Realizes Major Breakthrough"]

[Summary] The CAS Shanghai Institute of Optics and Fine Mechanics (SIOFM) high-tech research project entitled "Study of Ti:Sapphire Laser Crystals," under the direction of Research Fellow Deng Peizhen [6772 0160 3791], has realized a major breakthrough with its development of a large-size, high-efficiency, high-structural-integrity, high-quality-factor Ti:sapphire broadband tunable laser crystal with main performance indicators matching the world state-of-the-art. Such crystals have numerous applications in fields such as defense (ranging and communications), medicine, and industry. The SIOFM scientists have supplied these Ti:sapphire crystals to over 10 domestic institutions of higher

learning and research institutes, and are now engaged in cooperative research with colleagues in the United States and Japan.

**CD-ROM Production System Developed**

93P60272A Beijing RENMIN RIBAO OVERSEAS  
EDITION in Chinese 8 Jun 93 p 3

[Article by Wang Chu [3769 2806]: "Read-Only Digital Optical Disk Memory Production System Developed"]

[Summary] Shenzhen, 4 Jun (RENMIN RIBAO wire report)—A CD-ROM [compact disk read-only memory] full-line production system has been developed by Shenzhen Shenfei [3234 7378] Laser Optical Systems Ltd. Ten years' worth of RENMIN RIBAO can be stored on just one of these optical disks, which along with their mass production equipment have now been certified as meeting international standards by a panel of experts from the CAS in Beijing, Shanghai, and other places. This new production line marks China's entry into a select group of advanced nations able to master this new technology.

**Lattice Semiconductor Opens IC Design Office in Shanghai**

93P60281A Shanghai WEN HUI BAO in Chinese

2 Jun 93 p 2

[Article by Jin Dan [6855 0030]: "Lattice Semiconductor Corp. Settles in Caohejing"]

[Summary] The U.S. firm Lattice Semiconductor Corp., a specialist in programmable logic devices, yesterday settled in to its office in Shanghai's Caohejing High-Tech Park. Shanghai Lattice Semiconductor Ltd., funded by the U.S. Lattice Semiconductor Corp., plans within the next 2-3 years to design and develop 0.5-micron ICs. The formation of this new investment entity represents a major vehicle by which domestic silicon design experts can stride into the submicron era, accelerating the modernization of the nation's microelectronics technology.

**SUPERCONDUCTIVITY****Chinese Scholar, Swiss Scientists Jointly Develop World-Record-Tc Superconductor**

93P60282A Shanghai JIEFANG RIBAO in Chinese

22 May 93 p 5

[Unattributed article: "Chinese, Swiss Scientists Jointly Develop New Superconducting Material"]

[Summary] Bern, 20 May (XINHUA wire report)—Chinese visiting scholar in Switzerland Guo Jiandong [6753 1696 2767] and Swiss scientists have jointly developed a new superconductor with a world-record critical temperature. Guo and the Swiss Federal Higher Polytechnic University's Institute of Solid-State Physics research group, led by Prof. Ao-te [phonetic], used barium, calcium, copper, and mercury raw materials, and in April this year developed a Hg-Ba-Cu-O superconductor—heated for 5 hours at 800°C—that has a measured critical temperature of 133.5 K (-140°C).

**TELECOMMUNICATIONS R&D****Nation's Banking System To Invest 1 Billion Yuan for Satcom Network**

93P60270A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 19 May 93 p 1

[Article by Bao [7637]: "Nation's Banking System To Invest 1 Billion Yuan for Construction of Satellite Communications Network"]

[Text] An official in the Science & Technology Office of the People's Bank of China announced the other day that the

nation's banking system is investing 1 billion yuan this year to accelerate construction of a satellite communications backbone network, highlighted by construction of a China National [Financial] Network (CNFN), metropolitan networks, and [wide-area] networks. Last year, 138 small stations [i.e., VSATs] in a nationwide satcom electronic on-line system became operational; this satcom network basically covers first-level branch cities and mid-sized cities of coastal and riparian economically developed areas. The 44 nationwide first-level branches form a microcomputer telex network used for issuing currency.

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